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TABLES AND CHARTS FOR THE EVALUATION OF PROFILE DRAG FROM WAKE SURVEYS AT HIGH SUBSONIC SPEEDS

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RESTRICTED BULLETIN

TABLES AND CHARTS FOR THE EVALUATION OF PROFILE DRAG FROM WAKE SURVEYS AT HIGH SUBSONIC SPEEDS

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SUMMARY

Tables and charts for the evaluation of profile drag from wake surveys at high subsonic speeds are presented. These tables and charts are for use with two methods of evaluation, an exact method that may be applied to wakes of any shape and a simple approximate method that may be applied when the variation of total-pressure loss across the wake has the typical form (resembling a cycle of a cosine-squared curve).

INTRODUCTION

As an aid in the determination of profile drag from wake surveys at high subsonic speeds, tables and charts have been prepared to minimize the computational labor involved. These tables and charts are presented herein, together with a brief discussion of their application. The data are for both the approximate method of reference 1, which simply applies a correction factor to the integral of the total-pressure loss across the wake, and the exact point-by-point method, for use when the distribution of total-pressure loss across the wake does not follow the typical pattern. The data for both methods are for Mach numbers up to 1.0.

SYMBOLS

c	chord
d	drag per unit span

c_{d_o} section profile-drag coefficient $\left(\frac{d}{\frac{1}{2}\rho_o V_o^2 c}\right)$

F factor for evaluation of drag coefficient by approximate method

H total pressure

M Mach number

p static pressure

V velocity

w thickness of wake

y distance across wake

ρ density

Subscripts:

o free stream

1 at plane of measurement

max maximum

THEORY AND METHOD

The basic theory of the use of wake surveys for the measurement of wing profile drag has been largely discussed in previous literature (for example, reference 2). No further discussion of the equations used will therefore be given, except to note that the ratio of specific heats for air was taken as 1.404. Theoretical and experimental studies have confirmed that the basic assumptions - for example, that essentially streamline flow exists in the wake downstream of the measuring station and that the stagnation temperature in the wake is the same as in the free stream - are accurate or are satisfactory approximations to the actual conditions. Errors are more likely to arise from sources of a less fundamental nature, such as from cross flows of the wing boundary layer, which may confuse the relation between the wake at a certain spanwise station and the profile drag of the wing at that

station, or from so high a degree of turbulence in the wake (as behind a flap) that both the method and the pressure readings are invalid.

CHARTS AND TABLES FOR POINT-BY-POINT CALCULATIONS

The flight Mach number M_o and the flight impact pressure $H_o - p_o$ are assumed to be known, in addition to the values of total-pressure deficiency $H_o - H_1$ and of static-pressure rise $p_1 - p_o$ at points in the wake. Table I and figure 1 give the factor

$$\frac{d(cc_{d_o})}{dy} \Big/ \frac{H_o - H_1}{H_o - p_o}$$

or

$$\frac{\text{Drag per unit span per unit thickness of wake}}{\frac{1}{2}\rho_o V_o^2} \Big/ \frac{H_o - H_1}{H_o - p_o}$$

as a function of M_o, $\frac{H_o - H_1}{H_o - p_o}$, and $\frac{p_1 - p_o}{H_o - p_o}$. Multiplying this factor by the fractional loss of impact pressure at a point in the wake $\frac{H_o - H_1}{H_o - p_o}$ gives the value of cc_{d_o}, which corresponds to unit thickness of wake at that point. Integration of this value across the wake gives cc_{d_o} for the section.

The values given herein were computed in some detail for $M_o = 0$, 0.2, 0.4, 0.6, 0.8, and 1.0, and for $\frac{p_1 - p_o}{H_o - p_o} = -0.1$, 0, 0.1, and 0.2. The values for other Mach numbers and pressure ratios were found by interpolation and numerous calculated checks were made. The factors are accurate within ±0.002.

CHARTS FOR APPROXIMATE METHOD

When the distribution of total-pressure loss across the wake follows the typical pattern, profile drag can be obtained with good accuracy by a relatively simple method (reference 1). In this method, the drag is determined directly from the product of the integral of total-pressure loss across the wake $\int_w \frac{H_o - H_1}{H_o - p_o} dy_1$ and a factor F, which is a function of the maximum total-pressure loss in the wake, the average static pressure in the wake, and the flight Mach number; thus,

$$cc_{d_o} = F \int_w \frac{H_o - H_1}{H_o - p_o} dy_1$$

where F is a function of $\left(\frac{H_o - H_1}{H_o - p_o}\right)_{max}$, $\frac{p_1 - p_o}{H_o - p_o}$, and M_o. In practice the integral is obtained either by use of an integrating manometer or by actual integration of point-by-point measurements of $H_o - H_1$ in the wake.

Values of F are plotted in figure 2. The values were computed by assuming that the total-pressure loss across the wake had a cosine-squared distribution

$$\frac{H_o - H_1}{H_o - p_o} = \left(\frac{H_o - H_1}{H_o - p_o}\right)_{max} \cos^2 \frac{\pi y_1}{w} \qquad -\frac{w}{2} \leq y_1 \leq \frac{w}{2}$$

and by dividing the value of cc_{d_o}, as computed by the point-by-point method, by the value of $\int_w \frac{H_o - H_1}{H_o - p_o} dy_1$. Figure 2, which gives F directly for Mach numbers from 0 to 1.0, is considerably more convenient to use than the data of reference 1, which gives F directly only for $M_o = 0$ and includes a table of corrections for values of M_o other than zero. It should be pointed

out further that the correction table of reference 1 contains some systematic errors that are appreciable at high Mach numbers. The results presented herein are considered accurate (for an exact cosine-squared profile) to about ±0.2 percent.

Although this simplified procedure can greatly expedite the computation of wing profile drag, its application definitely requires that the wake profile bear a reasonable resemblance to the assumed cosine-squared profile, especially for wakes with large values of $\left(\frac{H_o - H_1}{H_o - p_o}\right)_{max}$. Even with an appreciable deformity from the usual profile, however, the error in the use of this method will hardly exceed 2 percent. As in the case of a shock where the wake profile shows a relatively narrow peak superimposed on a broad base (fig. 3), the error, however, may easily become excessive. When point-by-point measurements in the wake are available, accuracy can be retained in such a case by considering the wake in two parts, as indicated in figure 3; each part shows a satisfactory approximation to a cosine-squared profile but each has a different value of $\left(\frac{H_o - H_1}{H_o - p_o}\right)_{max}$.

RELATED CHARTS

Another paper (reference 3) has been prepared that gives results related to those given in the present paper. In reference 3, charts are given of the ratio of F for compressible flow to F for incompressible flow for Mach numbers to 1.0, for values of $\frac{p_1 - p_o}{H_o - p_o}$ from -0.4 to 0.1, and for values of $\left(\frac{H_o - H_1}{H_o - p_o}\right)_{max}$ from 0 to 0.7. A separate chart is given of F for incompressible flow.

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REFERENCES

1. Silverstein, A., and Katzoff, S.: A Simplified Method for Determining Wing Profile Drag in Flight. Jour. Aero. Sci., vol. 7, no. 7, May 1940, pp. 295-301.

2. Davis, Wallace F.: Comparison of Various Methods for Computing Drag from Wake Surveys. NACA ARR, Jan. 1943.

3. Heaslet, Max A.: Theoretical Investigation of Methods for Computing Drag from Wake Surveys at High Subsonic Speeds. NACA ARR No. 5C21, 1945.

ADDENDUM

The authors wish to call attention to the following related paper:

Baals, Donald D., and Mourhess, Mary J.: Numerical Evaluation of the Wake-Survey Equations for Subsonic Flow Including the Effect of Energy Addition. NACA ARR No. L5H27, 1945

which has appeared since publication of the present bulletin. The tables and charts of this related paper, which is concerned only with the point-by-point method, are for use not only with flows of constant total energy, as in normal wakes, but also with flows of increased total energy, as in wakes of propellers and jet-propulsion units. Total-pressure and static-pressure coefficients are based on $\frac{1}{2}\rho_o V_o^2$ instead of on $H_o - p_o$ as in the present bulletin.

TABLE I.- VALUES OF $\frac{d(cc_{d_o})}{dy} \Big/ \frac{H_o - H_1}{H_o - p_o}$ FOR EVALUATION OF PROFILE DRAG FROM WAKE SURVEY

$M_o = 0$

$\frac{H_o - H_1}{H_o - p_o}$ \ $\frac{p_1 - p_o}{H_o - p_o}$	-0.100	-0.075	-0.050	-0.025	0	0.025	0.050	0.075	0.100	0.125	0.150	0.175	0.200
0	1.048	1.036	1.024	1.012	1.000	0.988	0.975	0.962	0.949	0.936	0.923	0.909	0.895
.025	1.043	1.031	1.018	1.006	.994	.981	.968	.955	.942	.927	.915	.900	.886
.050	1.038	1.025	1.012	1.000	.987	.974	.961	.948	.934	.920	.907	.892	.877
.075	1.032	1.019	1.006	.993	.980	.967	.954	.940	.926	.912	.899	.883	.868
.100	1.026	1.013	1.000	.987	.973	.960	.946	.932	.918	.904	.890	.875	.859
.125	1.020	1.007	.994	.980	.966	.953	.938	.924	.910	.895	.881	.865	.849
.150	1.014	1.001	.988	.973	.959	.945	.930	.916	.901	.886	.871	.855	.839
.175	1.008	.995	.981	.966	.952	.937	.922	.908	.892	.877	.861	.845	.829
.200	1.002	.988	.974	.959	.944	.929	.914	.899	.883	.867	.851	.835	.818
.225	.995	.981	.967	.951	.936	.921	.905	.890	.874	.858	.841	.825	.807
.250	.988	.974	.959	.943	.928	.912	.896	.880	.864	.847	.830	.813	.795
.275	.981	.967	.951	.935	.920	.903	.887	.870	.854	.837	.819	.801	.783
.300	.974	.959	.943	.927	.911	.894	.878	.860	.844	.826	.808	.789	.770
.325	.967	.951	.935	.919	.902	.885	.868	.850	.833	.814	.796	.777	.757
.350	.959	.943	.927	.910	.893	.875	.858	.839	.821	.803	.783	.764	.743
.375	.951	.935	.918	.901	.883	.865	.847	.828	.809	.790	.770	.750	.728
.400	.943	.926	.909	.891	.873	.855	.836	.817	.797	.777	.756	.735	.713
.425	.935	.917	.899	.881	.863	.844	.824	.805	.784	.764	.741	.720	.697
.450	.926	.908	.889	.871	.852	.832	.811	.792	.770	.749	.726	.702	.679
.475	.917	.898	.879	.860	.840	.820	.798	.778	.756	.733	.710	.685	.661
.500	.908	.889	.869	849	.828	.807	.785	.763	.741	.718	.694	.669	.642
.525	.898	.879	.858	.837	.816	.794	.771	.748	.725	.701	.675	.648	.620
.550	.888	.868	.847	.825	.803	.781	.756	.733	.708	.683	.656	.627	.597
.575	.877	.856	.835	.812	.789	.766	.741	.717	.691	.664	.636	.606	.573
.600	.866	.844	.822	.799	.775	.750	.725	.699	.672	.645	.614	.582	.548
.625	.855	.832	.809	.785	.760	.734	.707	.681	.652	.622	.590	.557	.521
.650	.843	.819	.795	.770	.744	.717	.688	.660	.630	.597	.564	.525	.488
.675	.830	.806	.781	.754	.726	.698	.667	.637	.606	.570	.534	.493	.451
.700	.817	.792	.766	.737	.708	.678	.646	.613	.578	.540	.500	.456	.409
.725	.803	.777	.749	.719	.688	.656	.622	.587	.548	.508	.462	.416	.357
.750	.789	.760	.731	.699	.667	.634	.596	.558	.516	.470	.422	.365	.298
.775	.773	.742	.712	.678	.644	.605	.568	.524	.479	.429	.372	.303	.214
.800	.757	.724	.690	.655	.618	.579	.536	.488	.437	.379	.309	.218	0
.825	.740	.706	.670	.631	.590	.547	.498	.446	.386	.315	.223	0	
.850	.721	.685	.646	.604	.558	.509	.456	.395	.321	.228	0		
.875	.701	.662	.619	.572	.522	.466	.405	.330	.234	0			
.900	.679	.635	.587	.536	.480	.416	.340	.240	0				
.925	.657	.608	.550	.496	.430	.350	.248	0					
.950	.633	.578	.517	.448	.365	.258	0						
.975	.610	.546	.473	.386	.273	0							
1.000	.632	.548	.447	.316	0								

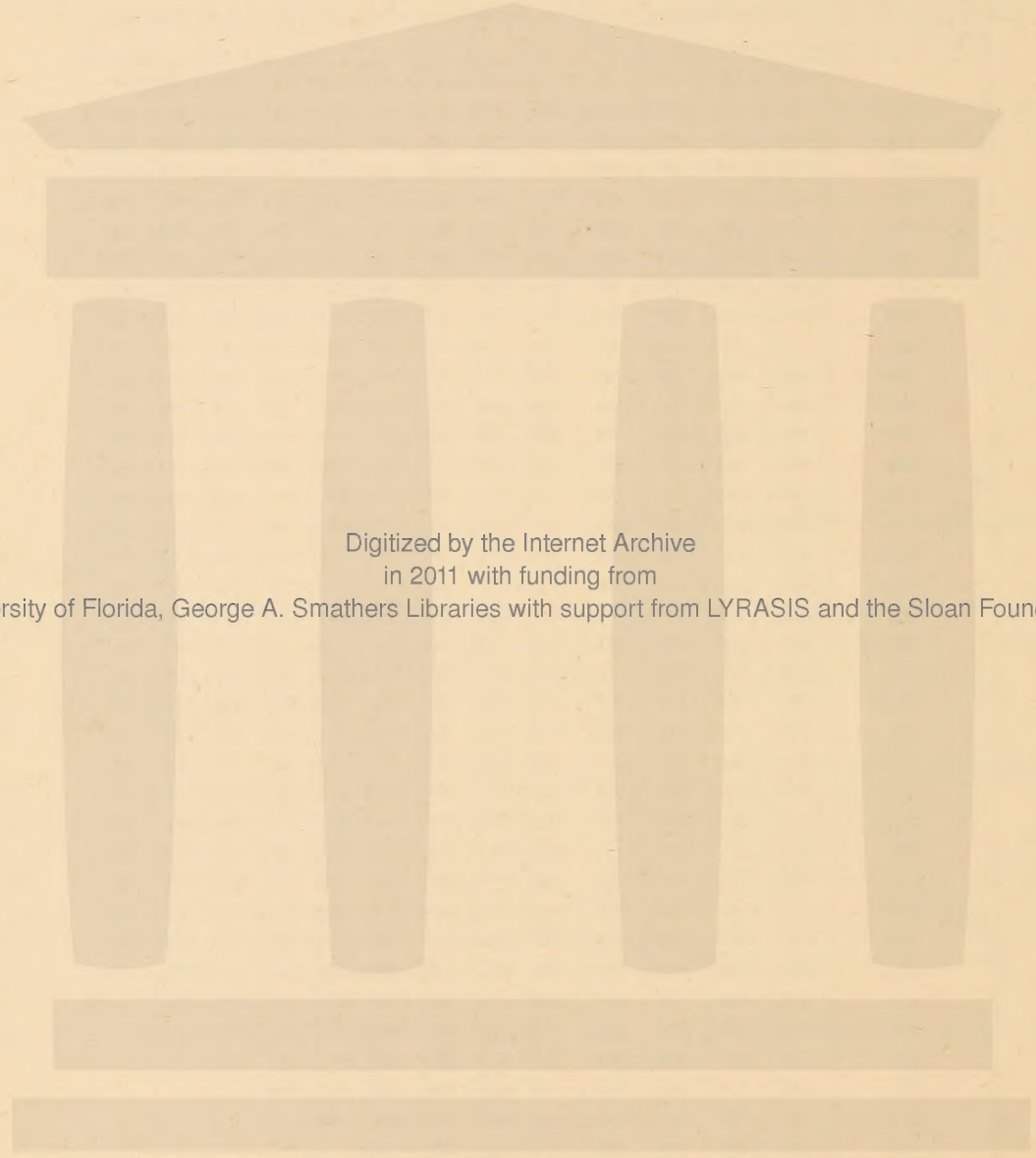

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TABLE I.- VALUES OF $\frac{d(cc_{d_o})}{dy} \Big/ \frac{H_o - H_1}{H_o - p_o}$ FOR EVALUATION

OF PROFILE DRAG FROM WAKE SURVEY - Continued

$M_o = 0.1$

$\frac{H_o - H_1}{H_o - p_o}$ \ $\frac{p_1 - p_o}{H_o - p_o}$	-0.100	-0.075	-0.050	-0.025	0	0.025	0.050	0.075	0.100	0.125	0.150	0.175	0.200
0	1.042	1.029	1.018	1.005	0.993	0.981	0.968	0.956	0.943	0.931	0.917	0.904	0.890
.025	1.037	1.024	1.013	.999	.987	.974	.961	.949	.936	.923	.910	.896	.882
.050	1.031	1.018	1.007	.994	.980	.968	.955	.942	.929	.915	.902	.887	.873
.075	1.025	1.013	1.001	.988	.973	.962	.948	.935	.921	.908	.894	.879	.864
.100	1.019	1.007	.994	.981	.967	.954	.941	.927	.914	.899	.885	.870	.855
.125	1.014	1.001	.988	.975	.961	.947	.933	.919	.905	.890	.876	.860	.845
150	1.008	.996	.982	.969	.954	.940	.925	.911	.896	.881	.867	.851	.835
.175	1.002	.989	.975	.962	.947	.932	.918	.903	.888	.873	.858	.842	.825
.200	.995	.981	.968	.954	.939	.925	.910	.894	.879	.863	.848	.832	.815
.225	.989	.975	.961	.947	.931	.916	.901	.886	.871	.854	.838	.821	.804
.250	.983	.969	.954	.939	.923	.908	.893	.877	.862	.845	.828	.810	.792
.275	.976	.963	.946	.932	.915	.899	.883	.867	.852	.833	.817	.799	.780
.300	.969	.955	.938	.923	.906	.890	.874	.857	.841	.823	.805	.787	.768
.325	.962	.947	.930	.914	.898	.881	.864	.847	.829	.812	.793	.774	.755
.350	.955	.939	.922	.905	.889	.871	.853	.836	.818	.799	.780	.761	.741
.375	.947	.930	.913	.896	.879	.861	.843	.824	.806	.786	.767	.747	.727
.400	.939	.921	.904	.887	.870	.850	.832	.812	.793	.773	.753	.732	.712
.425	.931	.913	.895	.877	.860	.840	.821	.801	.781	.760	.739	.718	.695
.450	.923	.905	.886	.868	.849	.829	.809	.789	.768	.747	.725	.702	.679
.475	.915	.895	.876	.857	.838	.818	.797	.776	.754	.732	.709	.685	.661
.500	.906	.886	.866	.846	.826	.805	.784	.762	.740	.716	.692	.666	.642
.525	.896	.876	.855	.835	.814	.792	.770	.747	.724	.699	.674	.647	.620
.550	.886	.866	.844	.824	.801	.779	.756	.732	.707	.680	.654	.627	.598
.575	.875	.855	.832	.811	.788	.764	.740	.715	.689	.661	.633	.604	.574
.600	.864	.844	.820	.797	.773	.749	.724	.697	.671	.640	.611	.580	.548
.625	.853	.831	.807	.783	.758	.732	.706	.677	.650	.619	.586	.556	.520
.650	.841	.818	.794	.769	.742	.715	.686	.657	.628	.595	.560	.525	.488
.675	.829	.804	.779	.752	.725	.696	.666	.635	.604	.570	.531	.493	.450
.700	.815	.789	.763	.734	.706	.676	.644	.612	.577	.540	.500	.457	.409
.725	.802	.775	.747	.716	.686	.654	.620	.586	.549	.508	.464	.415	.362
.750	.788	.759	.729	.697	.665	.631	.594	.557	.515	.472	.422	.367	.298
.775	.773	.743	.710	.676	.643	.604	.565	.525	.479	.430	.372	.304	.213
.800	.757	.725	.691	.655	.618	.577	.534	.488	.437	.378	.310	.218	0
.825	.739	.704	.669	.629	.590	.544	.499	.446	.386	.316	.223	0	
.850	.720	.683	.644	.603	.556	.510	.455	.395	.322	.228	0		
.875	.700	.659	.617	.574	.521	.465	.405	.330	.235	0			
.900	.679	.634	.585	.535	.476	.415	.340	.242	0				
.925	.657	.608	.552	.493	.429	.351	.249	0					
.950	.633	.578	.515	.444	.365	.260	0						
.975	.610	.546	.472	.381	.274	0							
1.000	.633	.547	.447	.316	0								

TABLE I.- VALUES OF $\frac{d(cc_{d_o})}{dy} \Big/ \frac{H_o - H_1}{H_o - p_o}$ FOR EVALUATION

OF PROFILE DRAG FROM WAKE SURVEY - Continued

$M_o = 0.2$

$\frac{H_o - H_1}{H_o - p_o}$ \ $\frac{p_1 - p_o}{H_o - p_o}$	-0.100	-0.075	-0.050	-0.025	0	0.025	0.050	0.075	0.100	0.125	0.150	0.175	0.200
0	1.028	1.017	1.006	0.994	0.982	0.970	0.958	0.946	0.933	0.921	0.908	0.895	0.881
.025	1.023	1.012	1.001	.988	.976	.964	.952	.939	.926	.913	.900	.887	.873
.050	1.018	1.007	.995	.983	.970	.958	.945	.932	.919	.906	.892	.879	.865
.075	1.013	1.001	.989	.977	.964	.952	.939	.925	.912	.898	.884	.870	.856
.100	1.007	.995	.983	.971	.958	.945	.932	.918	.904	.890	.876	.862	.847
.125	1.002	.989	.977	.964	.952	.938	.924	.910	.896	.882	.868	.853	.837
.150	.996	.983	.971	.958	.945	.931	.917	.902	.888	.874	.859	.844	.827
.175	.990	.978	.965	.951	.938	.923	.909	.895	.880	.865	.850	.834	.817
.200	.985	.972	.958	.944	.930	.917	.902	.887	.872	.856	.840	.824	.807
.225	.979	.965	.951	.937	.923	.909	.894	.879	.863	.847	.830	.814	.796
.250	.973	.959	.944	.930	.915	.901	.886	.870	.854	.837	.820	.803	.786
.275	.967	.952	.937	.922	.908	.893	.877	.860	.844	.827	.810	.793	.775
.300	.960	.945	.930	.915	.900	.884	.868	.851	.834	.817	.799	.781	.763
.325	.953	.938	.923	.908	.892	.876	.858	.841	.823	.805	.788	.769	.750
.350	.946	.931	.915	.899	.883	.866	.848	.830	.812	.794	.774	.756	.736
.375	.939	.923	.907	.890	.823	.855	.838	.819	.801	.782	.762	.742	.722
.400	.931	.915	.898	.881	.863	.845	.827	.808	.789	.769	.748	.727	.707
.425	.923	.907	.889	.872	.853	.836	.816	.797	.777	.756	.734	.713	.691
.450	.915	.897	.880	.862	.843	.824	.804	.785	.764	.742	.720	.699	.674
.475	.906	.888	.870	.851	.832	.812	.792	.771	.750	.727	.705	.682	.656
.500	.897	.879	.860	.841	.820	.800	.779	.758	.735	.713	.689	.664	.637
.525	.888	.869	.850	.830	.808	.787	.765	.743	.720	.697	.671	.646	.616
.550	.878	.859	.839	.819	.795	.773	.751	.728	.704	.678	.651	.624	.594
.575	.868	.848	.827	.806	.782	.759	.736	.712	.685	.659	.631	.603	.570
.600	.858	.837	.815	.792	.768	.744	.720	.694	.666	.639	.609	.578	.545
.625	.847	.824	.802	.778	.753	.728	.703	.675	.646	.616	.586	.552	.518
.650	.835	.811	.788	.762	.737	.711	.685	.656	.624	.594	.561	.524	.487
.675	.823	.798	.774	.747	.721	.693	.665	.635	.601	.568	.531	.493	.455
.700	.810	.785	.759	.732	.703	.674	.644	.611	.576	.538	.498	.458	.408
.725	.797	.769	.742	.714	.684	.652	.620	.586	.549	.507	.462	.415	.365
.750	.783	.754	.724	.694	.663	.629	.595	.557	.515	.469	.422	.368	.298
.775	.768	.738	.706	.674	.640	.604	.566	.526	.477	.428	.371	.304	.213
.800	.752	.719	.686	.651	.615	.576	.533	.486	.435	.378	.310	.218	0
.825	.735	.699	.664	.628	.588	.544	.497	.442	.386	.316	.224	0	
.850	.716	.679	.640	.602	.554	.508	.454	.395	.322	.230	0		
.875	.696	.658	.615	.572	.521	.465	.405	.328	.236	0			
.900	.675	.631	.585	.536	.480	.415	.340	.242	0				
.925	.654	.606	.554	.495	.429	.352	.249	0					
.950	.632	.579	.514	.443	.365	.260	0						
.975	.609	.545	.472	.381	.275	0							
1.000	.633	.546	.447	.316	0								

TABLE I.- VALUES OF $\frac{d(cc_{d_o})}{dy} \Big/ \frac{H_o - H_1}{H_o - p_o}$ FOR EVALUATION

OF PROFILE DRAG FROM WAKE SURVEY - Continued

$M_o = 0.3$

$\frac{H_o - H_1}{H_o - p_o}$ \ $\frac{p_1 - p_o}{H_o - p_o}$	-0.100	-0.075	-0.050	-0.025	0	0.025	0.050	0.075	0.100	0.125	0.150	0.175	0.200
0	1.004	0.994	0.983	0.972	0.962	0.949	0.938	0.926	0.914	0.902	0.890	0.878	0.865
.025	1.000	.990	.979	.968	.957	.944	.933	.920	.908	.896	.883	.871	.858
.050	.995	.986	.974	.963	.951	.938	.926	.914	.902	.890	.876	.863	.850
.075	.991	.980	.969	.957	.945	.932	.920	.908	.895	.882	.869	.855	.842
.100	.986	.974	.964	.951	.939	.927	.914	.901	.888	.875	.862	.847	.833
.125	.981	.969	.958	.945	.933	.921	.908	.894	.881	.867	.854	.838	.824
.150	.976	.964	.952	.939	.927	.914	.901	.887	.873	.859	.845	.830	.815
.175	.971	.958	.946	.933	.921	.907	.894	.880	.865	.851	.837	.822	.806
.200	.965	.952	.940	.927	.914	.901	.887	.873	.857	.843	.828	.812	.796
.225	.959	.946	.934	.921	.907	.894	.880	.866	.849	.835	.819	.802	.786
.250	.953	.940	.927	.914	.900	.886	.872	.857	.841	.826	.809	.793	.775
.275	.948	.934	.920	.907	.892	.878	.863	.848	.832	.816	.799	.783	.764
.300	.942	.927	.913	.899	.884	.870	.854	.837	.822	.804	.788	.771	.752
.325	.935	.920	.906	.892	.876	.862	.845	.828	.812	.794	.777	.758	.740
.350	.928	.914	.899	.885	.868	.854	.836	.820	.802	.784	.766	.746	.727
.375	.922	.907	.892	.877	.859	.844	.826	.809	.791	.772	.754	.733	.714
.400	.915	.900	.884	.867	.850	.833	.816	.798	.779	.761	.741	.720	.699
.425	.908	.892	.875	.858	.840	.823	.805	.787	.767	.748	.727	.706	.684
.450	.900	.883	.867	.848	.830	.812	.794	.774	.754	.734	.713	.691	.668
.475	.892	.874	.858	.839	.820	.801	.782	.763	.741	.720	.698	.674	.650
.500	.884	.866	.848	.828	.809	.789	.769	.748	.727	.704	.681	.657	.632
.525	.875	.858	.838	.818	.798	.777	.756	.734	.712	.688	.664	.639	.611
.550	.866	.848	.827	.807	.786	.765	.743	.720	.696	.672	.645	.620	.590
.575	.856	.838	.817	.797	.774	.752	.728	.704	.679	.652	.625	.598	.566
.600	.846	.827	.806	.784	.760	.737	.713	.687	.661	.633	.604	.574	.542
.625	.836	.816	.793	.770	.746	.721	.696	.669	.641	.612	.581	.548	.515
.650	.825	.803	.780	.756	.730	.704	.677	.649	.620	.588	.556	.522	.485
.675	.814	.790	.766	.741	.714	.687	.658	.629	.597	.564	.528	.491	.449
.700	.802	.777	.752	.725	.696	.667	.638	.606	.573	.536	.498	.455	.407
.725	.789	.763	.736	.707	.677	.647	.615	.581	.545	.505	.461	.413	.358
.750	.776	.748	.719	.688	.657	.626	.591	.553	.512	.469	.420	.363	.297
.775	.762	.732	.700	.668	.635	.599	.562	.521	.477	.427	.369	.302	.213
.800	.746	.714	.681	.647	.611	.572	.531	.485	.436	.377	.308	.217	0
.825	.730	.696	.660	.624	.584	.542	.494	.443	.385	.314	.222	0	
.850	.711	.677	.637	.597	.553	.504	.453	.394	.321	.227	0		
.875	.692	.652	.612	.566	.518	.464	.403	.328	.234	0			
.900	.671	.628	.582	.531	.475	.414	.340	.241	0				
.925	.650	.602	.549	.492	.427	.352	.248	0					
.950	.629	.572	.511	.444	.365	.260	0						
.975	.608	.544	.470	.379	.274	0							
1.000	.632	.546	.447	.316	0								

TABLE I.- VALUES OF $\frac{d(cc_{d_o})}{dy} \Big/ \frac{H_o - H_1}{H_o - p_o}$ FOR EVALUATION

OF PROFILE DRAG FROM WAKE SURVEY - Continued

$M_o = 0.4$

$\frac{H_o - H_1}{H_o - p_o}$ \ $\frac{p_1 - p_o}{H_o - p_o}$	-0.100	-0.075	-0.050	-0.025	0	0.025	0.050	0.075	0.100	0.125	0.150	0.175	0.200
0	0.972	0.963	0.953	0.943	0.933	0.922	0.912	0.901	0.890	0.879	0.868	0.857	0.845
.025	.968	.959	.949	.939	.928	.918	.907	.896	.884	.873	.862	.850	.837
.050	.964	.956	.945	.935	.923	.913	.901	.890	.878	.866	.856	.843	.831
.075	.960	.951	.940	.930	.919	.908	.895	.884	.872	.859	.849	.835	.823
.100	.955	.947	.935	.924	.915	.901	.889	.877	.865	.853	.842	.827	.814
.125	.952	.942	.930	.918	.910	.895	.883	.871	.858	.847	.834	.820	.807
.150	.946	.937	.925	.914	.903	.890	.877	.865	.852	.839	.826	.813	.798
.175	.943	.931	.920	.908	.896	.883	.871	.858	.844	.832	.818	.805	.789
.200	.938	.926	.914	.902	.890	.876	.864	.851	.838	.824	.810	.796	.780
.225	.933	.921	.909	.897	.884	.871	.857	.844	.829	.816	.801	.786	.770
.250	.928	.916	.903	.890	.877	.864	.850	.837	.822	.807	.792	.777	.760
.275	.923	.909	.897	.884	.870	.857	.842	.828	.813	.798	.783	.767	.750
.300	.917	.903	.890	.876	.863	.848	.834	.819	.805	.789	.773	.757	.739
.325	.911	.897	.884	.870	.856	.841	.826	.811	.794	.779	.763	.745	.727
.350	.906	.891	.877	.863	.848	.834	.817	.802	.784	.768	.752	.733	.715
.375	.900	.884	.870	.855	.840	.825	.808	.792	.774	.757	.741	.721	.702
.400	.894	.878	.862	.848	.832	.816	.798	.783	.762	.747	.728	.708	.686
.425	.887	.871	.854	.839	.823	.806	.788	.772	.753	.735	.716	.694	.673
.450	.880	.863	.846	.831	.814	.797	.778	.760	.742	.722	.702	.679	.658
.475	.873	.856	.838	.822	.804	.787	.767	.749	.729	.709	.688	.664	.641
.500	.865	.848	.830	.813	.795	.776	.756	.737	.715	.694	.672	.648	.623
.525	.857	.840	.821	.803	.783	.764	.744	.723	.702	.679	.656	.630	.605
.550	.849	.832	.812	.793	.772	.752	.731	.708	.686	.663	.637	.611	.584
.575	.841	.823	.802	.783	.761	.740	.717	.693	.670	.646	.617	.591	.562
.600	.831	.813	.792	.771	.748	.727	.701	.678	.652	.624	.597	.568	.536
.625	.821	.802	.781	.758	.735	.711	.686	.659	.632	.604	.574	.542	.509
.650	.811	.791	.768	.744	.721	.695	.668	.641	.612	.582	.549	.514	.478
.675	.800	.779	.755	.731	.705	.678	.650	.622	.590	.557	.521	.484	.444
.700	.789	.766	.742	.716	.688	.661	.631	.599	.566	.528	.491	.450	.404
.725	.777	.753	.727	.699	.670	.640	.609	.574	.539	.499	.456	.409	.358
.750	.765	.728	.711	.681	.651	.619	.584	.547	.507	.463	.415	.360	.295
.775	.752	.723	.694	.663	.630	.595	.557	.516	.472	.422	.366	.301	.213
.800	.737	.707	.676	.642	.606	.568	.526	.481	.431	.374	.307	.216	0
.825	.721	.689	.656	.618	.580	.537	.491	.441	.382	.313	.220	0	
.850	.705	.671	.632	.594	.550	.501	.451	.392	.320	.226	0		
.875	.686	.648	.608	.564	.515	.463	.401	.329	.233	0			
.900	.667	.625	.579	.530	.475	.414	.338	.240	0				
.925	.647	.599	.548	.491	.426	.350	.247	0					
.950	.625	.571	.510	.443	.363	.260	0						
.975	.605	.542	.469	.381	.274	0							
1.000	.631	.547	.447	.317	0								

TABLE I.- VALUES OF $\frac{d(cc_{d_o})}{dy} \Big/ \frac{H_o - H_1}{H_o - p_o}$ FOR EVALUATION

OF PROFILE DRAG FROM WAKE SURVEY - Continued

$M_o = 0.5$

$\frac{H_o - H_1}{H_o - p_o}$ \ $\frac{p_1 - p_o}{H_o - p_o}$	-0.100	-0.075	-0.050	-0.025	0	0.025	0.050	0.075	0.100	0.125	0.150	0.175	0.200
0	0.932	0.923	0.915	0.906	0.898	0.888	0.878	0.870	0.860	0.850	0.840	0.829	0.817
.025	.929	.921	.912	.903	.894	.884	.874	.865	.855	.844	.834	.823	.811
.050	.926	.917	.908	.899	.890	.880	.870	.860	.850	.838	.828	.817	.805
.075	.923	.913	.904	.895	.886	.875	.865	.854	.844	.832	.822	.809	.798
.100	.920	.909	.900	.890	.882	.870	.860	.848	.838	.827	.816	.803	.791
.125	.916	.905	.896	.885	.877	.864	.855	.842	.832	.820	.809	.797	.784
.150	.912	.902	.892	.881	.872	.860	.850	.837	.826	.814	.802	.790	.776
.175	.908	.898	.888	.877	.867	.856	.844	.832	.820	.809	.795	.783	.768
.200	.904	.895	.884	.873	.862	.851	.838	.827	.814	.802	.788	.775	.760
.225	.900	.890	.879	.868	.857	.846	.832	.821	.807	.794	.780	.767	.751
.250	.896	.886	.874	.863	.851	.839	.825	.814	.799	.786	.772	.757	.742
.275	.891	.880	.869	.857	.845	.832	.818	.806	.791	.777	.763	.747	.733
.300	.887	.875	.863	.850	.839	.824	.811	.797	.783	.768	.754	.738	.723
.325	.882	.870	.857	.844	.832	.818	.804	.789	.774	.761	.744	.729	.712
.350	.878	.865	.851	.839	.825	.811	.796	.782	.765	.752	.734	.718	.700
.375	.873	.859	.845	.832	.818	.803	.788	.773	.756	.741	.723	.707	.688
.400	.867	.853	.839	.824	.811	.795	.780	.764	.746	.731	.712	.696	.675
.425	.861	.847	.833	.818	.803	.787	.771	.753	.735	.718	.699	.682	.662
.450	.855	.841	.826	.811	.795	.779	.762	.741	.724	.706	.686	.667	.648
.475	.849	.834	.818	.804	.786	.769	.751	.732	.713	.693	.673	.652	.631
.500	.843	.827	.810	.795	.777	.759	.740	.722	.701	.680	.659	.637	.614
.525	.836	.819	.802	.786	.768	.748	.729	.709	.688	.667	.644	.621	.596
.550	.829	.812	.794	.776	.758	.738	.716	.696	.674	.652	.628	.604	.576
.575	.822	.804	.785	.765	.747	.726	.704	.682	.657	.634	.609	.584	.555
.600	.814	.795	.775	.755	.735	.712	.690	.667	.640	.616	.588	.561	.531
.625	.805	.784	.764	.743	.722	.699	.674	.649	.623	.596	.567	.536	.505
.650	.796	.774	.753	.731	.708	.684	.658	.633	.604	.576	.543	.511	.475
.675	.786	.763	.741	.717	.692	.667	.640	.613	.583	.552	.518	.482	.440
.700	.775	.751	.728	.703	.676	.650	.622	.592	.560	.525	.487	.447	.401
.725	.764	.738	.715	.686	.659	.631	.601	.568	.533	.496	.454	.407	.355
.750	.753	.725	.699	.669	.641	.609	.579	.541	.502	.461	.413	.360	.292
.775	.740	.712	.683	.652	.621	.587	.553	.512	.469	.419	.366	.298	.211
.800	.727	.698	.666	.634	.599	.562	.522	.477	.428	.372	.305	.215	0
.825	.712	.681	.647	.611	.574	.532	.487	.437	.380	.312	.220	0	
.850	.696	.663	.626	.587	.546	.499	.448	.388	.319	.225	0		
.875	.679	.641	.602	.557	.512	.459	.397	.328	.232	0			
.900	.662	.619	.575	.524	.472	.410	.337	.239	0				
.925	.642	.594	.543	.487	.424	.350	.247	0					
.950	.620	.566	.506	.439	.363	.259	0						
.975	.600	.539	.468	.376	.273	0							
1.000	.630	.547	.447	.317	0								

TABLE I.- VALUES OF $\frac{d(cc_{d_o})}{dy} \Big/ \frac{H_o - H_1}{H_o - p_o}$ FOR EVALUATION

OF PROFILE DRAG FROM WAKE SURVEY - Continued

$M_o = 0.6$

$\frac{H_o - H_1}{H_o - p_o}$ \ $\frac{p_1 - p_o}{H_o - p_o}$	-0.100	-0.075	-0.050	-0.025	0	0.025	0.050	0.075	0.100	0.125	0.150	0.175	0.200
0	0.885	0.877	0.871	0.864	0.856	0.849	0.840	0.833	0.824	0.816	0.806	0.798	0.789
.025	.882	.875	.868	.860	.852	.845	.836	.828	.820	.811	.801	.792	.783
.050	.879	.872	.865	.857	.849	.841	.832	.825	.815	.806	.796	.787	.777
.075	.878	.869	.862	.855	.845	.837	.828	.820	810	.801	.791	.782	.771
.100	.876	.867	.859	.852	.842	.834	.824	.816	.805	.797	.786	.776	.766
.125	.873	.864	.856	.847	.838	.830	.820	.812	.800	.792	.781	.770	.759
.150	.871	.861	.853	.843	.835	.826	.816	.807	.795	.787	.775	.765	.753
.175	.867	.858	.849	.841	.831	.822	.812	.803	.790	.782	.769	.758	.745
.200	.864	.855	.845	.837	.828	.818	.807	.797	.786	.775	.763	.750	.737
.225	.861	.852	.841	.833	.823	.813	.802	.792	.780	.768	.756	.743	.729
.250	.859	.848	.838	.828	.819	.808	.796	.786	.774	.762	.748	.736	.722
.275	.855	.845	.834	.824	.813	.802	.790	.779	.766	.754	.740	.727	.712
.300	.851	.841	.830	.820	.808	.797	.784	.772	.760	.747	.733	.718	.703
.325	.847	.837	.825	.815	.803	.791	.778	.765	.752	.739	.724	.709	.693
.350	.843	.832	.820	.808	.797	.784	.772	.758	.744	.730	.715	.700	.683
.375	.839	.827	.815	.803	.791	.777	.764	.749	.736	.720	.706	.689	.671
.400	.835	.823	.810	.798	.785	.770	.756	.742	.727	.710	.695	.677	.660
.425	.830	.818	.805	.792	.778	.763	.748	.733	.717	.700	.684	.665	.646
.450	.826	.812	.799	.785	.771	.756	.739	.725	.708	.691	.672	.654	.633
.475	.820	.806	.793	.778	.763	.747	.730	.715	.697	.680	.659	.640	.618
.500	.815	.800	.786	.770	.755	.737	.721	.704	.685	.667	.645	.625	.602
.525	.809	.794	.778	.763	.746	.728	.711	.692	.674	.653	.630	.609	.585
.550	.803	.787	.770	.754	.737	.718	.699	.680	.661	.639	.615	.592	.566
.575	.796	.779	.762	.744	.728	.707	.687	.667	.646	.622	.598	.573	.545
.600	.789	.772	.754	.736	.717	.696	.675	.653	.631	.605	.580	.552	.522
.625	.782	.764	.745	.726	.705	.684	.661	.638	.614	.587	.559	.528	.496
.650	.775	.755	.735	.714	.693	.670	.646	.622	.595	.566	.535	.502	.467
.675	.766	.745	.724	.702	.679	.656	.630	.603	.574	.543	.509	.473	.434
.700	.757	.735	.712	.689	.664	.640	.612	.582	.551	.516	.480	.440	.395
.725	.747	.725	.700	.675	.649	.621	.591	.559	.525	.487	.447	.401	.350
.750	.736	.712	.686	.658	.631	.600	.568	.534	.496	.454	.409	.355	.291
.775	.725	.698	.671	.642	.611	.578	.544	.505	.462	.417	.361	.296	.210
.800	.712	.684	.656	.624	.590	.554	.514	.472	.425	.369	.301	.214	0
.825	.700	.670	.638	.604	.566	.526	.482	.435	.377	.308	.219	0	
.850	.685	.654	.619	.581	.540	.493	.445	.386	.318	.224	0		
.875	.670	.635	.595	.555	.506	.455	.395	.327	.231	0			
.900	.653	.614	.570	.523	.468	.409	.335	.238	0				
.925	.634	.589	.540	.485	.422	.346	.246	0					
.950	.615	.565	.508	.441	.360	.258	0						
.975	.598	.537	.466	.385	.273	0							
1.000	.629	.547	.448	.318	0								

TABLE I.- VALUES OF $\frac{d(cc_{d_o})}{dy} \Big/ \frac{H_o - H_1}{H_o - p_o}$ FOR EVALUATION

OF PROFILE DRAG FROM WAKE SURVEY - Continued

$M_o = 0.7$

$\frac{H_o - H_1}{H_o - p_o}$ \ $\frac{p_1 - p_o}{H_o - p_o}$	-0.100	-0.075	-0.050	-0.025	0	0.025	0.050	0.075	0.100	0.125	0.150	0.175	0.200
0	0.835	0.830	0.824	0.818	0.813	0.807	0.800	0.794	0.787	0.780	0.772	0.765	0.757
.025	.833	.828	.822	.816	.811	.805	.798	.791	.784	.776	.768	.760	.752
.050	.831	.826	.819	.814	.809	.802	.795	.788	.780	.772	.764	.755	.747
.075	.829	.824	.818	.812	.806	.800	.793	.785	.777	.768	.759	.750	.742
.100	.827	.821	.816	.809	.804	.797	.789	.781	.773	.764	.755	.746	.737
.125	.826	.819	.814	.807	.801	.793	.786	.777	.769	.761	.751	.742	.732
.150	.825	.818	.812	.805	.798	.791	.784	.775	.765	.757	.748	.737	.726
.175	.823	.816	.809	.802	.795	.788	.780	.771	.761	.752	.743	.732	.720
.200	.821	.814	.807	.799	.792	.784	.775	.766	.756	.746	.736	.725	.714
.225	.819	.812	.804	.795	.788	.779	.770	.760	.751	.740	.729	.718	.707
.250	.816	.810	.802	.793	.784	.775	.766	.756	.746	.734	.723	.712	.699
.275	.814	.807	.798	.789	.780	.770	.761	.750	.740	.727	.716	.704	.691
.300	.812	.804	.795	.786	.776	.767	.756	.745	.734	.721	.708	.696	.683
.325	.810	.800	.791	.782	.771	.762	.751	.739	.727	.714	.701	.688	.674
.350	.807	.798	.788	.777	.766	.757	.746	.733	.720	.707	.693	.679	.665
.375	.804	.794	.783	.773	.761	.751	.739	.726	.713	.699	.685	.670	.654
.400	.800	.790	.778	.768	.756	.744	.732	.719	.705	.691	.676	.660	.643
.425	.797	.786	.774	.763	.750	.738	.725	.711	.696	.682	.666	.649	.631
.450	.793	.781	.769	.758	.744	.731	.718	.703	.687	.671	.655	.637	.619
.475	.789	.776	.764	.751	.737	.723	.709	.693	.678	.661	.643	.624	.604
.500	.785	.771	.758	.744	.730	.715	.700	.683	.667	.649	.630	.610	.589
.525	.780	.766	.752	.738	.723	.707	.690	.673	.656	.636	.616	.595	.573
.550	.774	.760	.745	.730	.715	.698	.681	.662	.643	.622	.601	.578	.556
.575	.769	.754	.738	.723	.706	.689	.670	.650	.630	.607	.586	.560	.536
.600	.763	.747	.731	.714	.697	.678	.659	.638	.615	.592	.568	.543	.515
.625	.756	.741	.723	.705	.686	.667	.646	.624	.600	.575	.549	.519	.490
.650	.750	.733	.714	.695	.675	.654	.632	.609	.584	.556	.527	.495	.461
.675	.743	.724	.705	.684	.663	.641	.617	.591	.564	.534	.504	.466	.429
.700	.734	.714	.695	.672	.650	.626	.600	.573	.542	.508	.475	.437	.390
.725	.725	.705	.683	.660	.635	.609	.582	.552	.518	.482	.443	.397	.344
.750	.716	.694	.671	.647	.620	.591	.560	.527	.490	.450	.405	.351	.287
.775	.707	.683	.658	.630	.602	.571	.537	.501	.459	.412	.359	.293	.209
.800	.696	.671	.643	.613	.582	.547	.509	.468	.420	.367	.300	.213	0
.825	.685	.656	.626	.594	.560	.521	.478	.430	.375	.309	.218	0	
.850	.672	.641	.607	.571	.533	.489	.441	.383	.315	.223	0		
.875	.658	.624	.585	.546	.501	.452	.391	.323	.230	0			
.900	.643	.603	.561	.515	.465	.407	.332	.237	0				
.925	.628	.581	.532	.478	.418	.344	.245	0					
.950	.609	.557	.499	.435	.358	.256	0						
.975	.591	.532	.465	.374	.272	0							
1.000	.627	.547	.448	.319	0								

TABLE I.- VALUES OF $\frac{d(cc_{d_o})}{dy} \Big/ \frac{H_o - H_1}{H_o - p_o}$ FOR EVALUATION

OF PROFILE DRAG FROM WAKE SURVEY - Continued

$M_o = 0.8$

$\frac{H_o - H_1}{H_o - p_o}$ \ $\frac{p_1 - p_o}{H_o - p_o}$	-0.100	-0.075	-0.050	-0.025	0	0.025	0.050	0.075	0.100	0.125	0.150	0.175	0.200
0	0.781	0.778	0.775	0.772	0.767	0.763	0.758	0.753	0.748	0.743	0.737	0.731	0.725
.025	.780	.777	.774	.770	.765	.761	.757	.752	.746	.740	.734	.727	.721
.050	.780	.777	.773	.769	.764	.760	.755	.749	.743	.737	.730	.723	.717
.075	.779	.775	.771	.767	.762	.757	.752	.746	.740	.733	.726	.718	.713
.100	.778	.774	.770	.765	.761	.755	.749	.743	.738	.730	.723	.715	.709
.125	.777	.773	.769	.764	.759	.753	.747	.741	.735	.727	.719	.711	.703
.150	.776	.772	.767	.762	.756	.751	.744	.737	.731	.723	.715	.707	.699
.175	.775	.770	.765	.760	.754	.747	.741	.735	.728	.720	.711	.702	.693
.200	.774	.769	.763	.758	.752	.745	.738	.731	.723	.716	.706	.697	.688
.225	.773	.767	.762	.756	.749	.743	.735	.728	.719	.711	.702	.692	.681
.250	.772	.766	.760	.753	.747	.739	.731	.724	.715	.706	.697	.686	.675
.275	.770	.764	.757	.750	.744	.735	.727	.718	.710	.700	.691	.680	.667
.300	.768	.762	.755	.748	.741	.733	.724	.715	.705	.694	.685	.673	.661
.325	.766	.760	.753	.746	.738	.729	.720	.710	.700	.689	.678	.666	.652
.350	.765	.757	.750	.742	.733	.724	.714	.704	.694	.683	.670	.658	.644
.375	.763	.755	.747	.738	.728	.719	.709	.699	.687	.675	.662	.649	.635
.400	.760	.752	.744	.735	.725	.714	.703	.694	.681	.667	.654	.640	.625
.425	.758	.749	.740	.730	.720	.709	.697	.687	.674	.660	.645	.631	.615
.450	.755	.746	.736	.725	.715	.703	.691	.679	.665	.651	.636	.620	.602
.475	.752	.742	.731	.721	.709	.698	.685	.671	.657	.641	.625	.608	.590
.500	.749	.739	.727	.716	.704	.692	.677	.663	.647	.631	.613	.595	.576
.525	.745	.734	.722	.712	.698	.684	.669	.653	.637	.619	.600	.581	.561
.550	.741	.729	.717	.705	.691	.675	.660	.643	.626	.607	.587	.567	.544
.575	.737	.724	.711	.698	.683	.667	.650	.633	.614	.593	.572	.549	.525
.600	.733	.718	.704	.690	.675	.658	.639	.621	.601	.579	.556	.531	.504
.625	.727	.713	.697	.681	.665	.648	.628	.608	.585	.562	.537	.509	.481
.650	.722	.706	.690	.673	.655	.636	.615	.593	.569	.544	.516	.486	.454
.675	.716	.699	.682	.664	.645	.623	.601	.576	.552	.522	.491	.458	.421
.700	.710	.691	.673	.655	.633	.611	.585	.559	.531	.498	.464	.428	.385
.725	.703	.684	.663	.643	.620	.595	.568	.540	.509	.473	.435	.392	.341
.750	.695	.675	.653	.630	.605	.578	.549	.517	.482	.442	.399	.347	.286
.775	.687	.665	.642	.617	.589	.560	.526	.490	.451	.406	.354	.292	.208
.800	.677	.654	.629	.600	.570	.537	.500	.460	.414	.361	.298	.212	0
.825	.667	.642	.613	.582	.549	.512	.470	.424	.369	.305	.217	0	
.850	.656	.627	.595	.561	.524	.481	.433	.377	.312	.222	0		
.875	.644	.610	.576	.538	.494	.447	.388	.320	.228	0			
.900	.631	.592	.552	.509	.458	.401	.330	.235	0				
.925	.615	.571	.525	.476	.415	.342	.244	0					
.950	.601	.548	.492	.429	.355	.255	0						
.975	.587	.529	.462	.375	.271	0							
1.000	.625	.546	.449	.320	0								

TABLE I.- VALUES OF $\frac{d(cc_{d_o})}{dy} \Big/ \frac{H_o - H_1}{H_o - p_o}$ FOR EVALUATION

OF PROFILE DRAG FROM WAKE SURVEY - Continued

$M_o = 0.9$

$\frac{H_o - H_1}{H_o - p_o}$ \ $\frac{p_1 - p_o}{H_o - p_o}$	-0.100	-0.075	-0.050	-0.025	0	0.025	0.050	0.075	0.100	0.125	0.150	0.175	0.200
0	0.725	0.724	0.723	0.722	0.720	0.717	0.715	0.712	0.707	0.705	0.700	0.697	0.690
.025	.726	.724	.723	.721	.719	.716	.713	.710	.706	.703	.698	.694	.688
.050	.727	.724	.723	.720	.718	.715	.712	.708	.705	.701	.696	.691	.685
.075	.726	.724	.723	.720	.717	.714	.711	.707	.704	.698	.694	.688	.682
.100	.726	.723	721	.719	.716	.713	.709	.705	.701	.696	.691	.685	.678
.125	.725	.723	.721	.719	.715	.712	.708	.703	.699	.693	.688	.682	.675
.150	.725	.722	.720	.718	.715	.710	.706	.700	.694	.689	.684	.678	.671
.175	.725	.722	.720	.718	.714	.709	.704	.698	.692	.686	.680	.673	.667
.200	.724	.722	.719	.716	.712	.707	.702	.695	.689	.683	.676	.669	.662
.225	.724	.722	.719	.715	.710	.705	.700	.693	.687	.680	.673	.665	.657
.250	.723	.720	.717	.712	.708	.702	.697	.691	.684	.677	.669	.660	.651
.275	.723	.720	.716	.711	.705	.700	.693	.687	.680	.672	.663	.654	.645
.300	.722	.719	.714	.709	.703	.697	.690	.683	.676	.667	.658	.648	.639
.325	.721	.718	.714	.708	.700	.696	.688	.680	.672	.662	.652	.642	.632
.350	.720	.716	.712	.706	.698	.693	.685	.676	.667	.657	.646	.635	.624
.375	.719	.714	.709	.702	.695	.688	.681	.672	.662	.651	.640	.628	.616
.400	.718	.712	.706	.699	.691	.684	.675	.666	.655	.644	.633	.620	.606
.425	.716	.710	.704	.696	.688	.680	.670	.660	.649	.637	.625	.611	.596
.450	.715	.708	.701	.693	.684	.674	.665	.653	.642	.629	.616	.602	.588
.475	.713	.706	.698	.690	.680	.669	.659	.647	.635	.620	.606	.591	.574
.500	.711	.703	.695	.686	.675	.664	.653	.640	.626	.611	.595	.579	.561
.525	.708	.699	.690	.680	.670	.658	.646	.633	.617	.601	.585	.567	.547
.550	.705	.696	.687	.676	.664	.652	.638	.624	.607	.591	.573	.553	.531
.575	.702	.693	.682	.671	.658	.644	.629	.613	.596	.578	.558	.537	.514
.600	.699	.688	.677	.665	.651	.637	.620	.603	.584	.563	.542	.518	.494
.625	.695	.684	.672	.658	.643	.628	.610	.590	.570	.548	.525	.500	.472
.650	.691	.679	.665	.651	.635	.618	.598	.577	.555	.531	.505	.476	.445
.675	.686	.674	.659	.643	.625	.607	.585	.562	.538	.510	.482	.450	.415
.700	.682	.667	.651	.634	.615	.594	.571	.546	.518	.488	.456	.420	.378
.725	.675	.660	.643	.623	.603	.580	.555	.529	.496	.465	.426	.385	.340
.750	.670	.653	.634	.612	.590	.565	.537	.507	.472	.435	.391	.345	.283
.775	.662	.644	.623	.599	.575	.546	.516	.482	.444	.400	.350	.289	.205
.800	.655	.635	.610	.586	.557	.527	.493	.454	.409	.357	.295	.210	0
.825	.647	.624	.596	.568	.537	.502	.463	.418	.365	.302	.215	0	
.850	.638	.611	.580	.548	.513	.475	.428	.374	.309	.220	0		
.875	.627	.596	.564	.525	.487	.438	.384	.316	.225	0			
.900	.616	.581	.541	.499	.451	.395	.325	.232	0				
.925	.605	.563	.517	.467	.411	.337	.242	0					
.950	.591	.542	.488	.427	.353	.254	0						
.975	.578	.523	.459	.373	.272	0							
1.000	.623	.545	.449	.321	0								

TABLE I.- VALUES OF $\frac{d(cc_{d_o})}{dy} \Big/ \frac{H_o - H_1}{H_o - p_o}$ FOR EVALUATION

OF PROFILE DRAG FROM WAKE SURVEY - Concluded

$M_o = 1.0$

$\frac{H_o - H_1}{H_o - p_o}$ \ $\frac{p_1 - p_o}{H_o - p_o}$	-0.100	-0.075	-0.050	-0.025	0	0.025	0.050	0.075	0.100	0.125	0.150	0.175	0.200
0	0.669	0.672	0.673	0.674	0.673	0.673	0.672	0.671	0.669	0.667	0.665	0.662	0.659
.025	.670	.672	.673	.674	.673	.673	.672	.670	.668	.666	.663	.660	.658
.050	.671	.673	.673	.674	.673	.673	.671	.669	.667	.665	.662	.659	.655
.075	.671	.672	.672	.672	.672	.672	.670	.668	.666	.663	.660	.656	.652
.100	.672	.673	.672	.672	.672	.671	.670	.668	.665	.662	.658	.655	.649
.125	.674	.674	.673	.672	.671	.669	.668	.666	.663	.660	.655	.652	.646
.150	.674	.674	.673	.672	.671	.668	.666	.664	.661	.657	.653	.649	.643
.175	.675	.674	.673	.672	.670	.668	.665	.662	.659	.655	.650	.644	.638
.200	.675	.673	.673	.672	.670	.667	.664	.660	.656	.651	.646	.641	.635
.225	.675	.674	.674	.672	.669	.667	.664	.659	.654	.648	.643	.637	.630
.250	.675	.673	.673	.670	.668	.665	.662	.657	.652	.646	.640	.633	.626
.275	.675	.673	.672	.670	.666	.663	.659	.654	.649	.643	.636	.628	.620
.300	.675	.673	.672	.669	.665	.661	.656	.651	.646	.639	.631	.623	.615
.325	.675	.673	.670	.667	.663	.659	.654	.648	.642	.635	.627	.618	.609
.350	.675	.673	.670	.666	.662	.657	.652	.645	.638	.630	.621	.612	.602
.375	.675	.672	.669	.665	.660	.654	.649	.642	.634	.625	.616	.606	.595
.400	.674	.670	.666	.662	.657	.651	.645	.637	.629	.620	.610	.599	.587
.425	.674	.670	.665	.660	.655	.648	.641	.633	.624	.614	.603	.592	.579
.450	.673	.669	.664	.658	.652	.644	.636	.627	.618	.608	.596	.585	.569
.475	.672	.666	.662	.655	.648	.640	.632	.621	.612	.601	.588	.575	.558
.500	.671	.665	.659	.652	.645	.635	.626	.616	.605	.592	.578	.563	.547
.525	.669	.662	.656	.648	.640	.630	.620	.609	.597	.583	.567	.551	.534
.550	.667	.660	.654	.645	.636	.624	.613	.601	.589	.573	.556	.538	.519
.575	.665	.657	.650	.640	.631	.619	.606	.593	.579	.562	.543	.523	.502
.600	.664	.655	.646	.636	.625	.613	.599	.584	.568	.549	.528	.507	.484
.625	.661	.652	.643	.630	.620	.605	.589	.573	.555	.535	.512	.488	.461
.650	.658	.648	.637	.625	.613	.597	.579	.560	.542	.520	.493	.467	.435
.675	.655	.645	.633	.619	.605	.587	.567	.547	.526	.500	.471	.440	.405
.700	.652	.640	.626	.611	.595	.576	.554	.531	.508	.477	.447	.411	.370
.725	.648	.635	.620	.603	.585	.563	.540	.515	.487	.454	.418	.377	.330
.750	.644	.628	.612	.593	.573	.550	.522	.495	.462	.427	.385	.337	.280
.775	.638	.621	.602	.582	.560	.535	.503	.471	.436	.394	.346	.286	.204
.800	.633	.614	.592	.569	.544	.517	.481	.445	.403	.353	.292	.208	0
.825	.625	.604	.579	.553	.525	.493	.455	.412	.360	.298	.213	0	
.850	.618	.593	.565	.535	.502	.466	.422	.370	.306	.218	0		
.875	.609	.581	.549	.515	.479	.432	.379	.315	.225	0			
.900	.600	.567	.529	.490	.443	.390	.325	.232	0				
.925	.590	.553	.507	.457	.407	.336	.241	0					
.950	.580	.533	.479	.420	.352	.253	0						
.975	.572	.518	.455	.372	.270	0							
1.000	.619	.544	.450	.322	0								

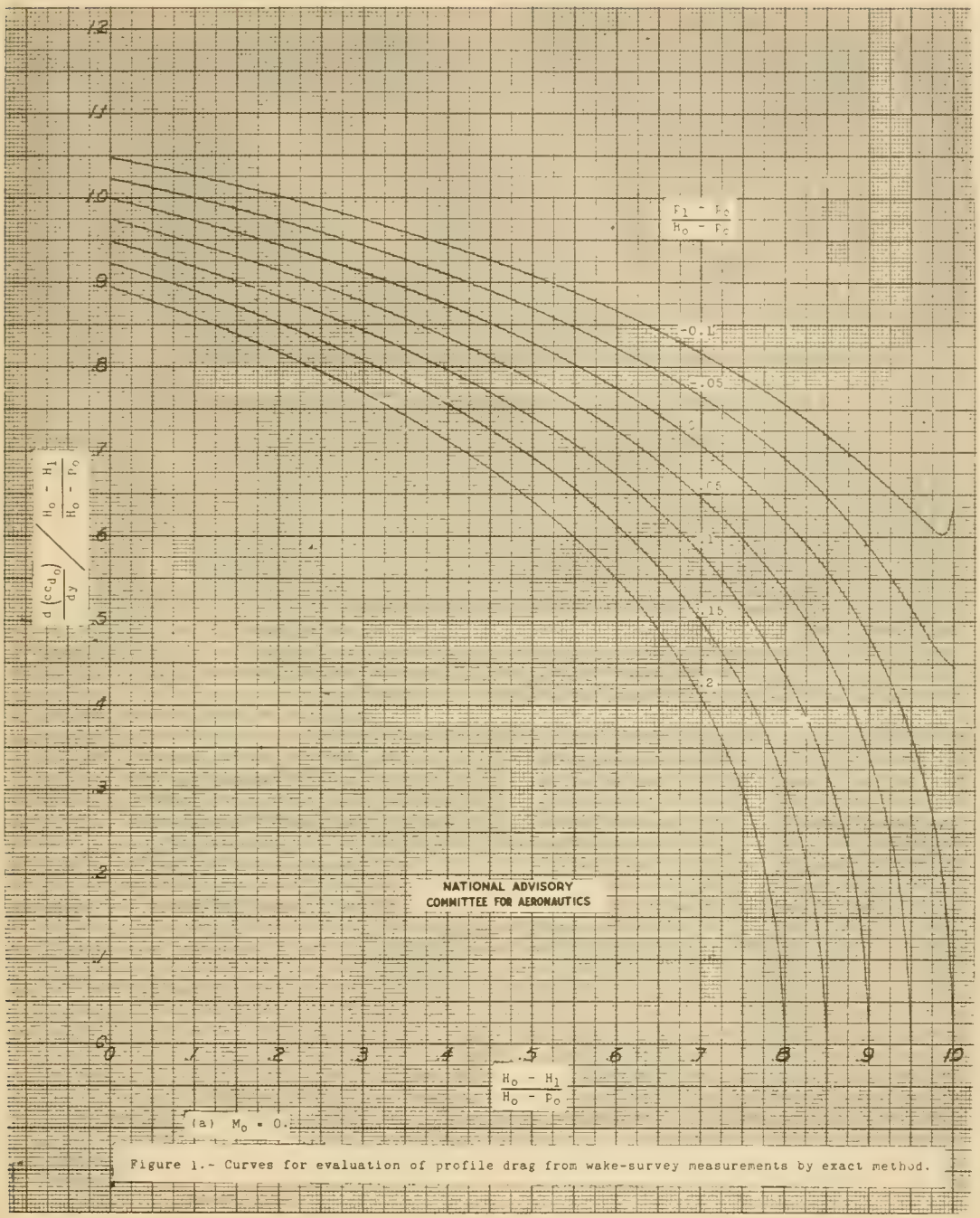
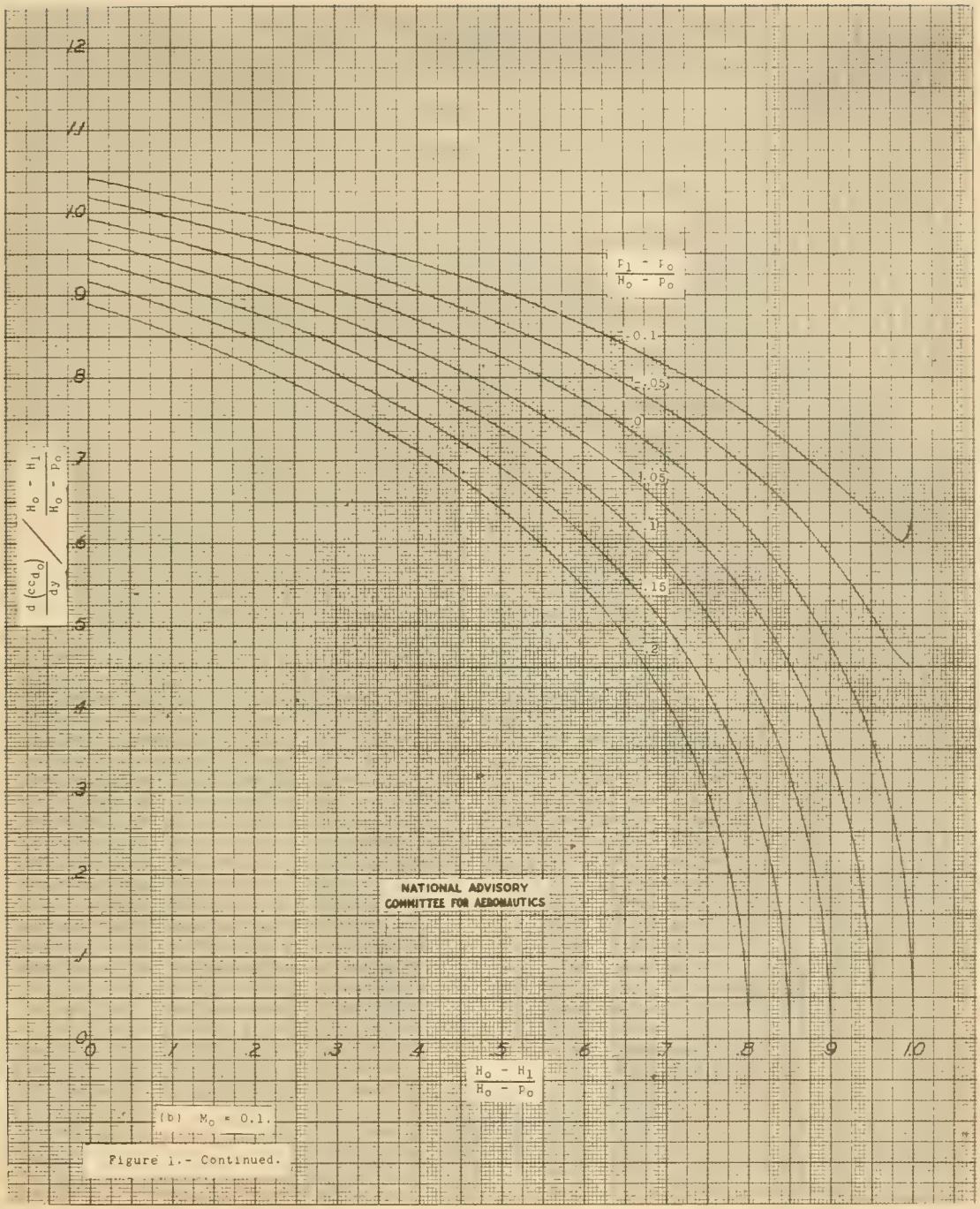
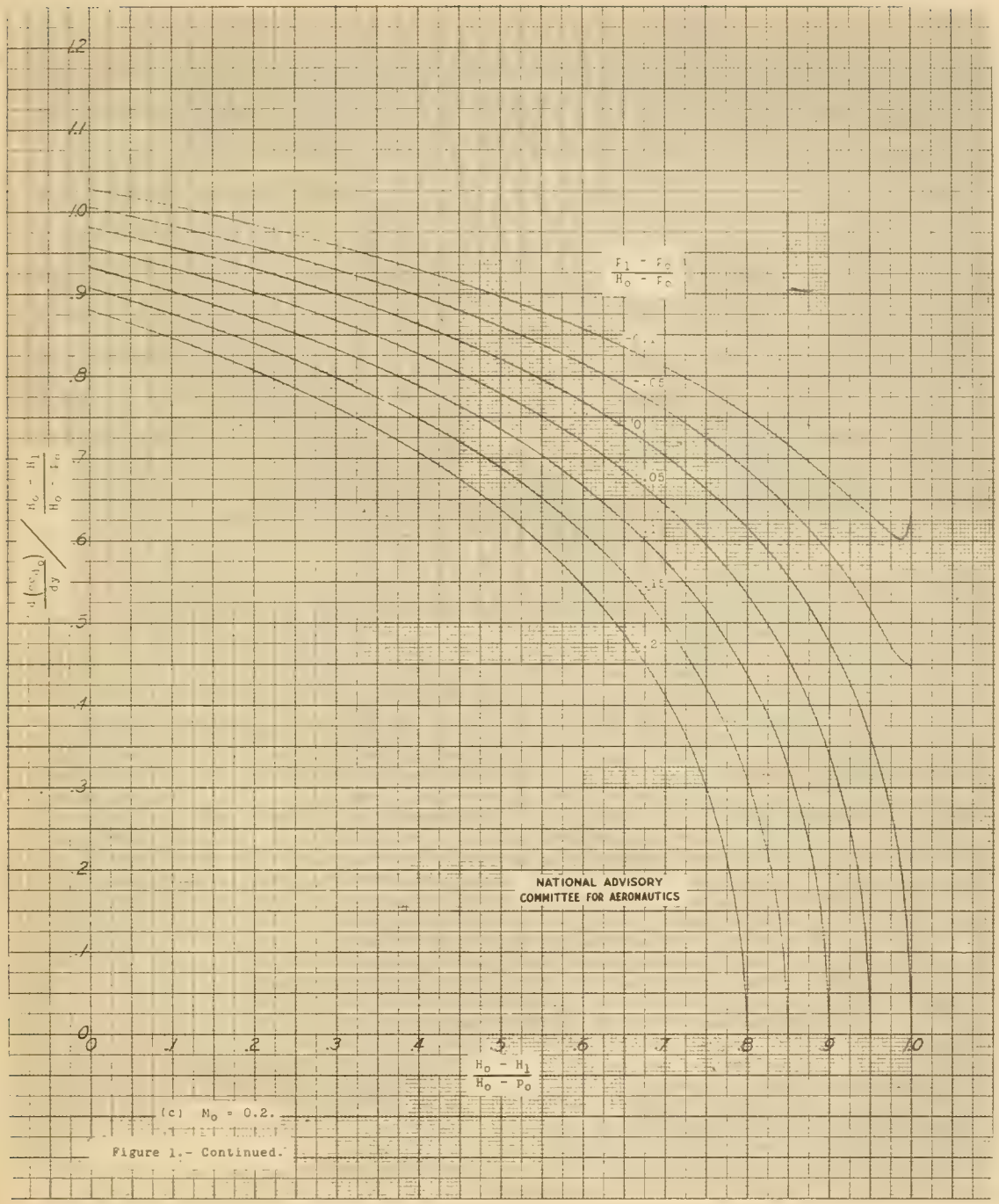


Figure 1.- Curves for evaluation of profile drag from wake-survey measurements by exact method.



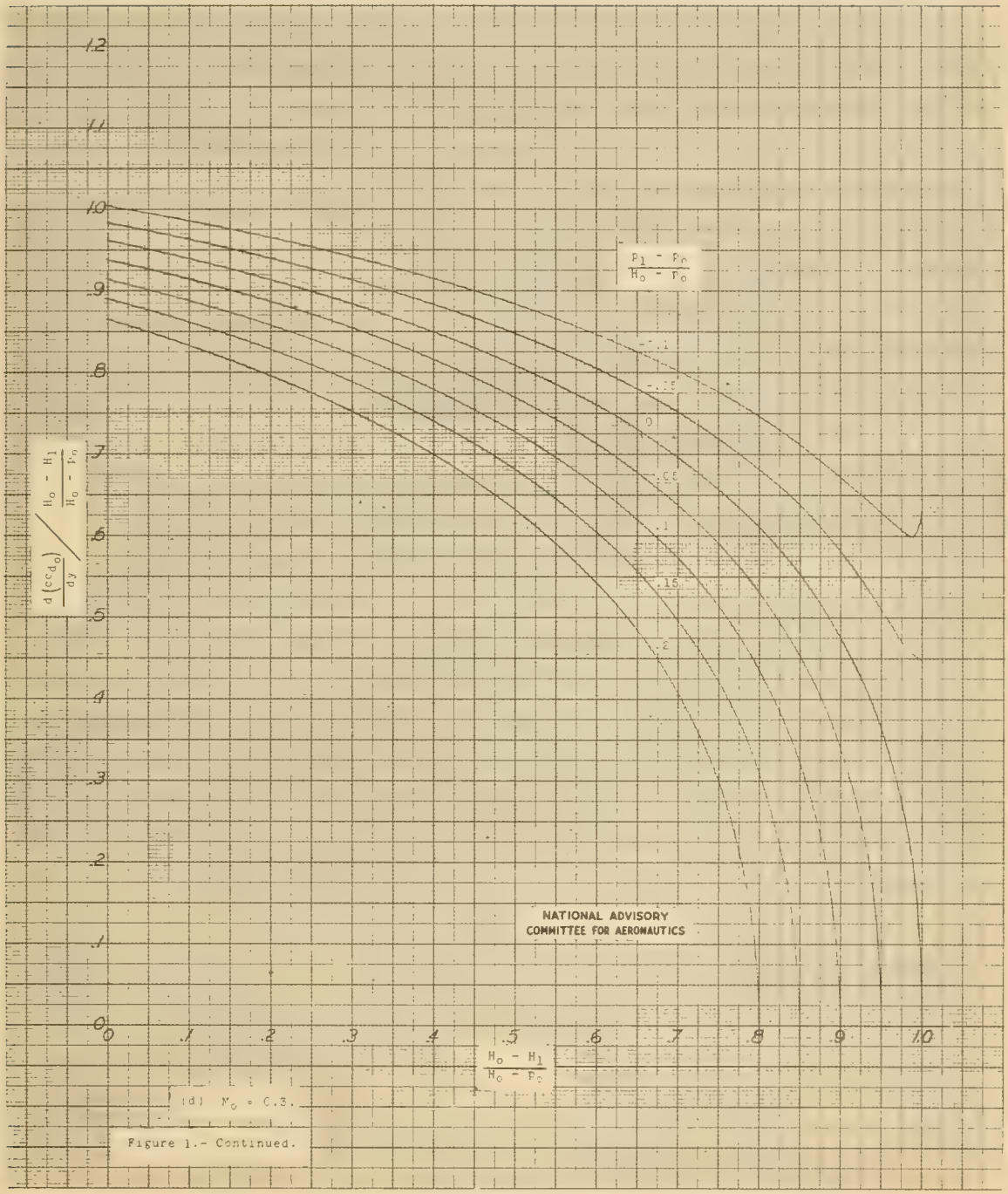
(b) $M_o = 0.1$.

Figure 1.- Continued.



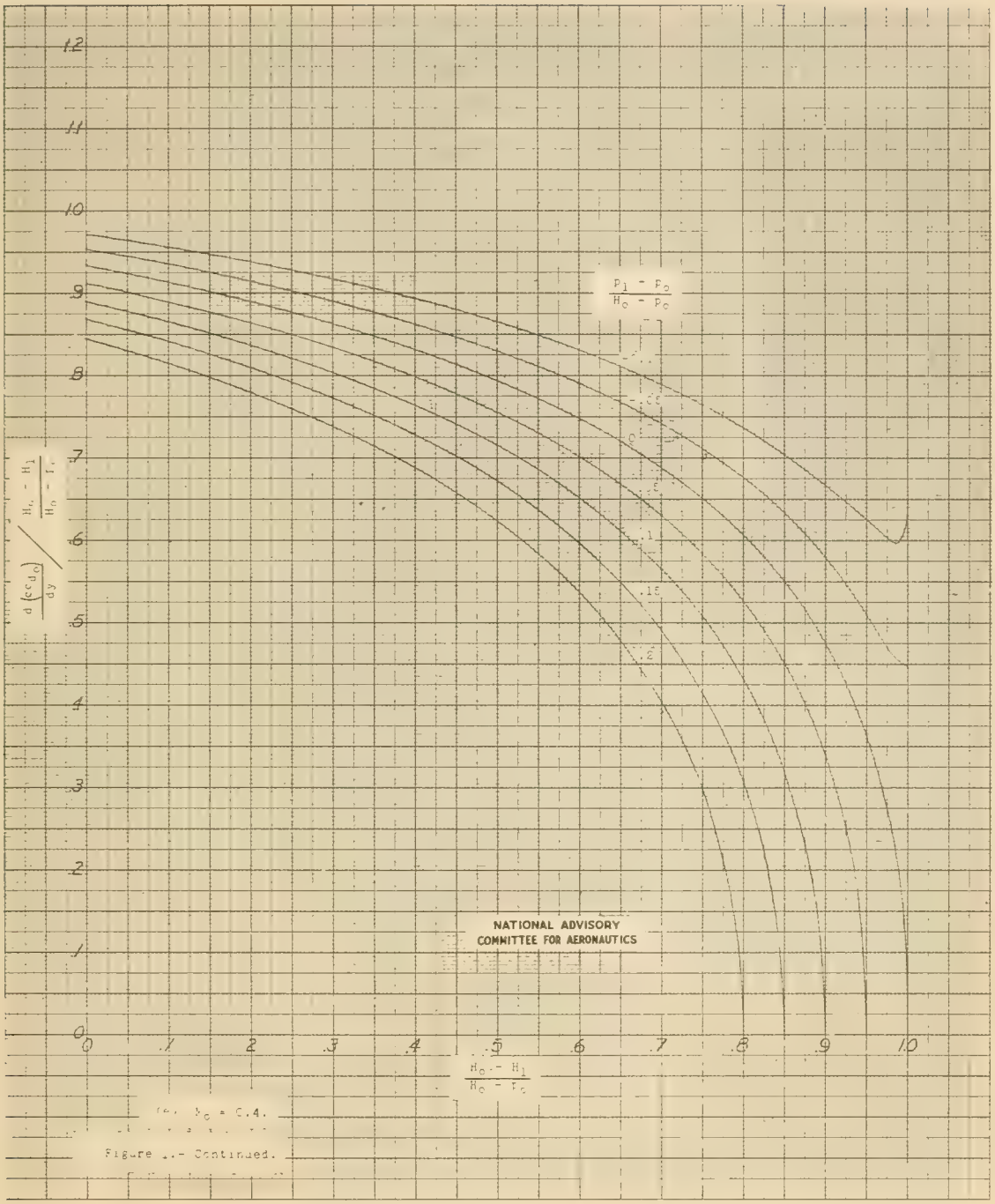
(c) $M_o = 0.2$.

Figure 1.- Continued.



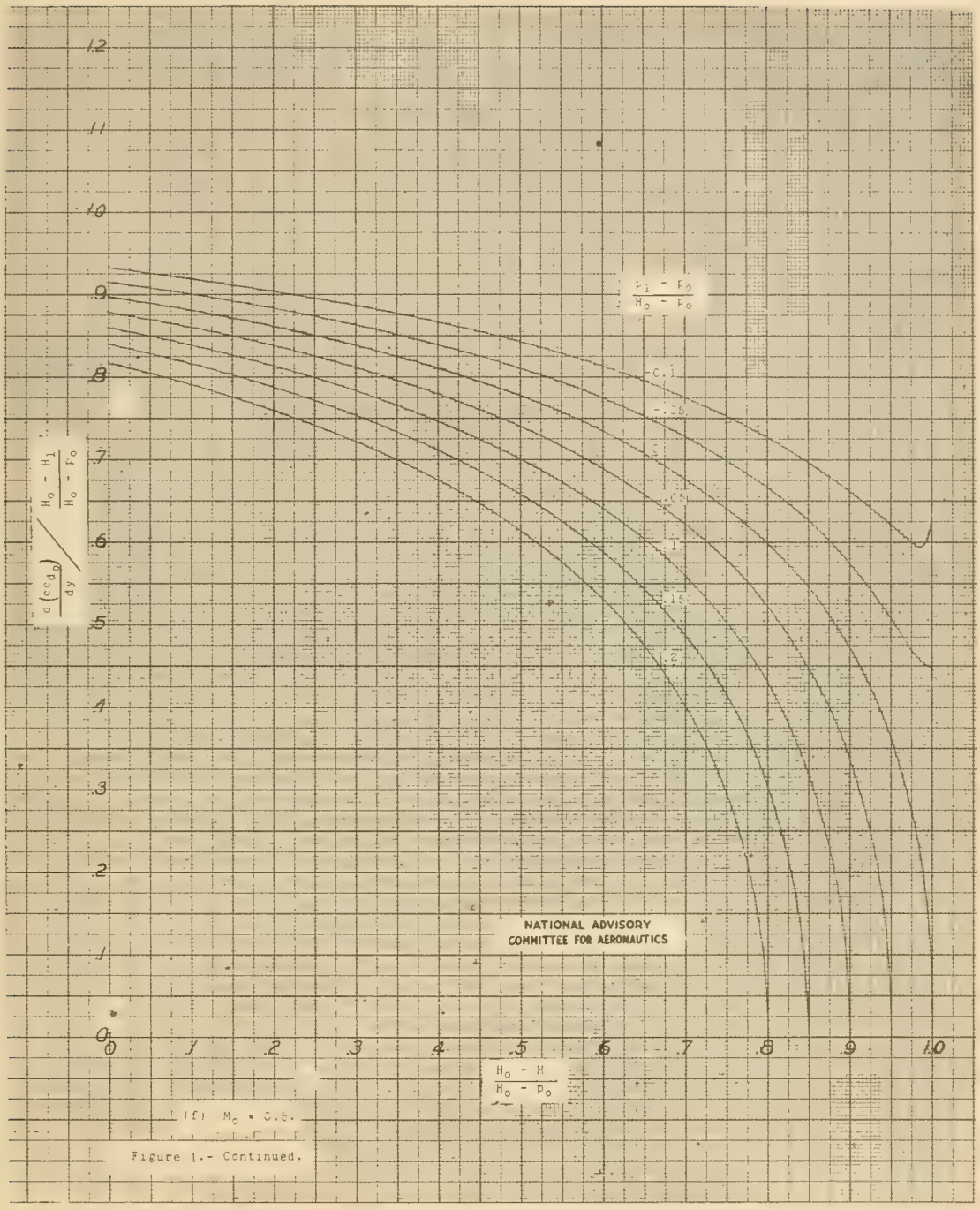
(d) M_o = 0.3.

Figure 1.- Continued.



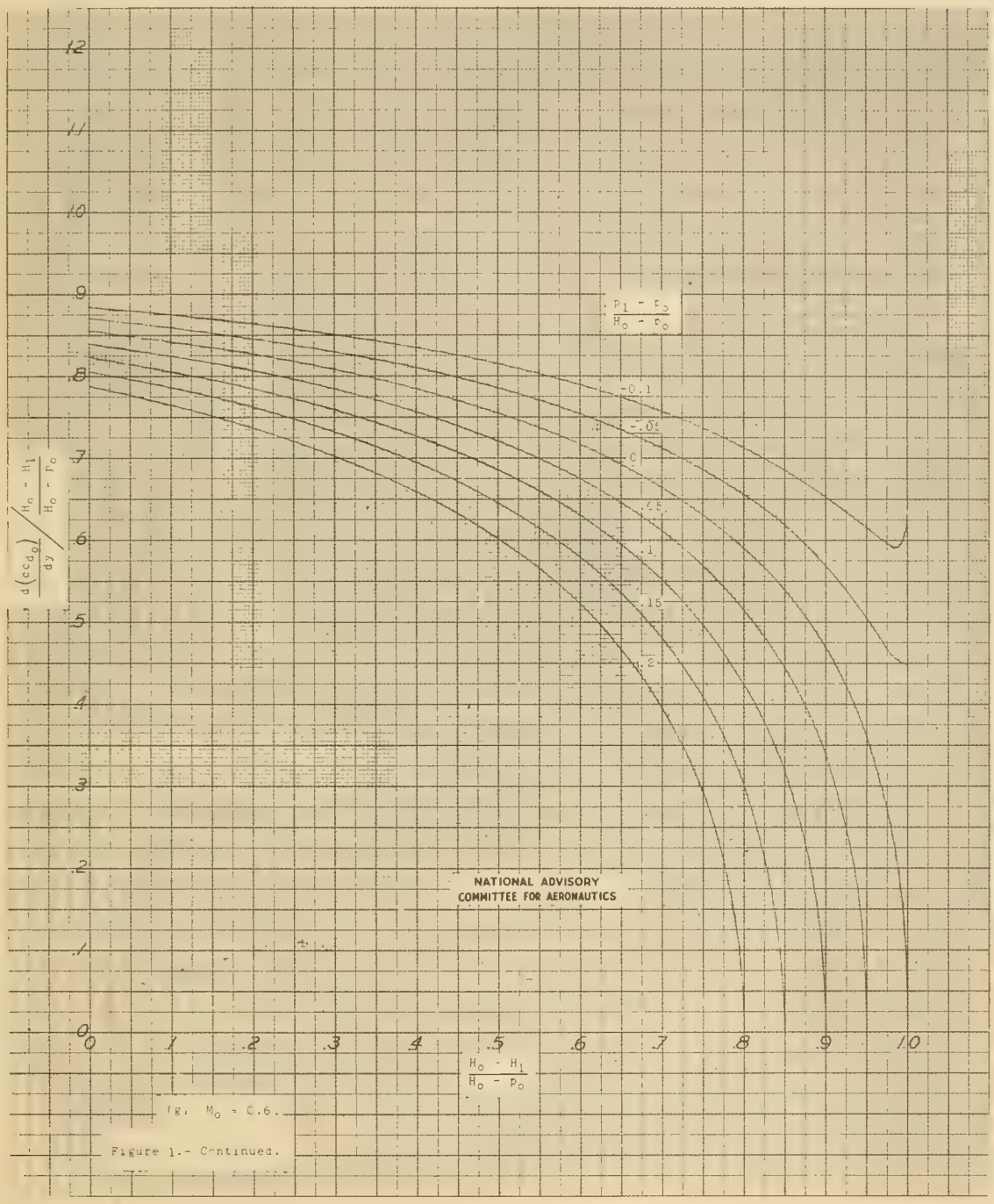
(e) $M_0 = 0.4$.

Figure 1.- Continued.



(f) M_o = 0.5.

Figure 1.- Continued.



(g) $M_o = 0.6$.

Figure 1.- Continued.

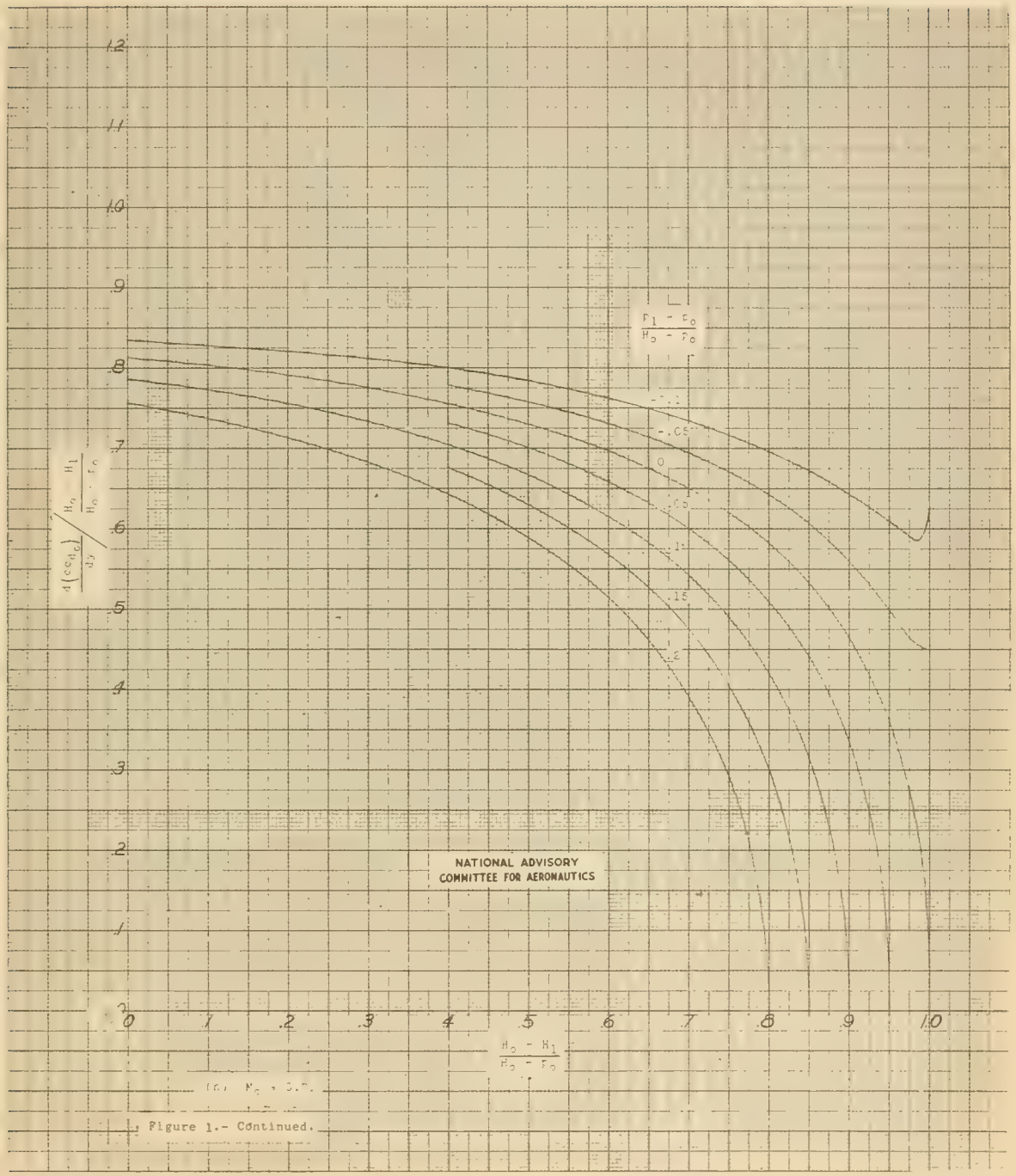
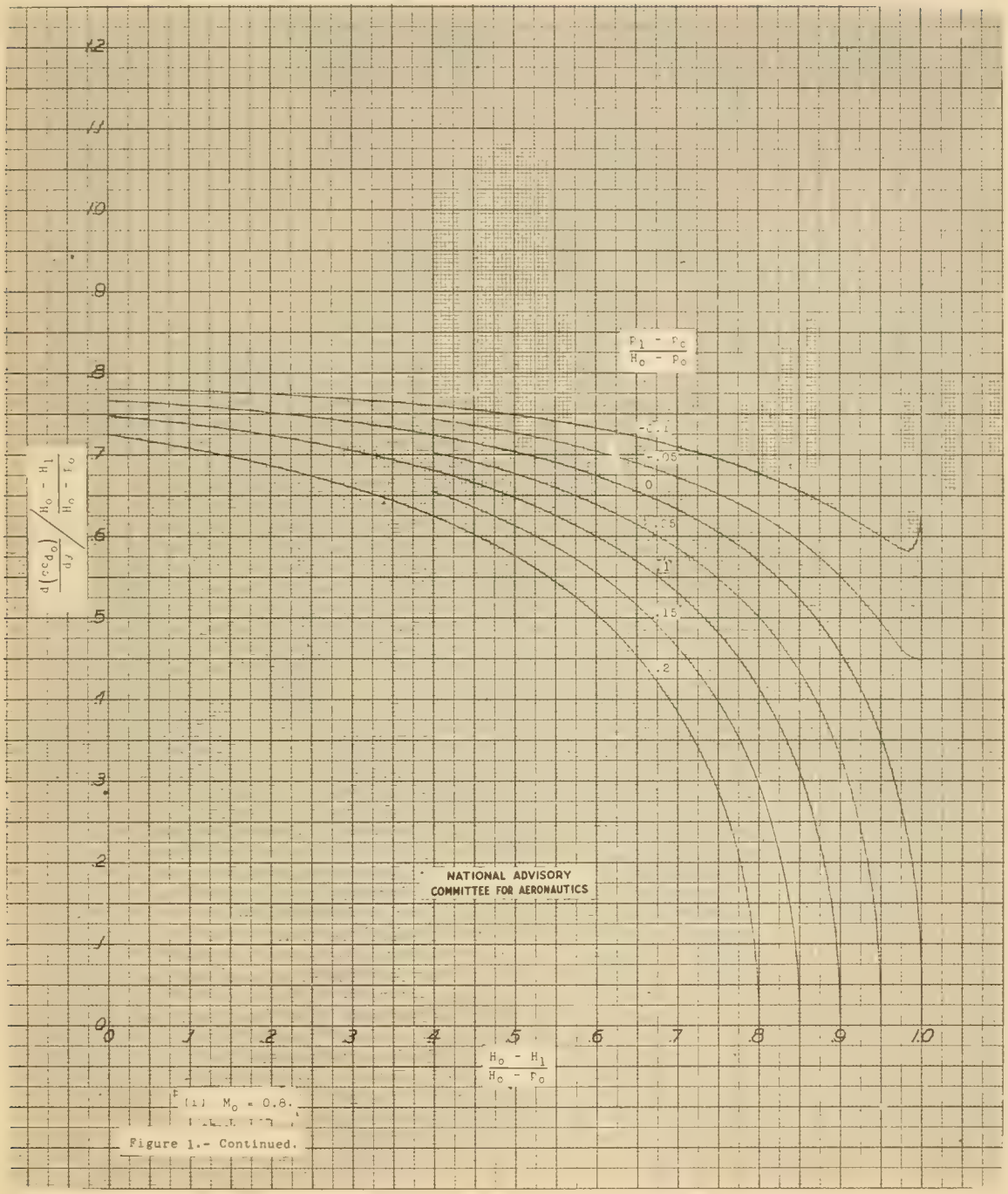
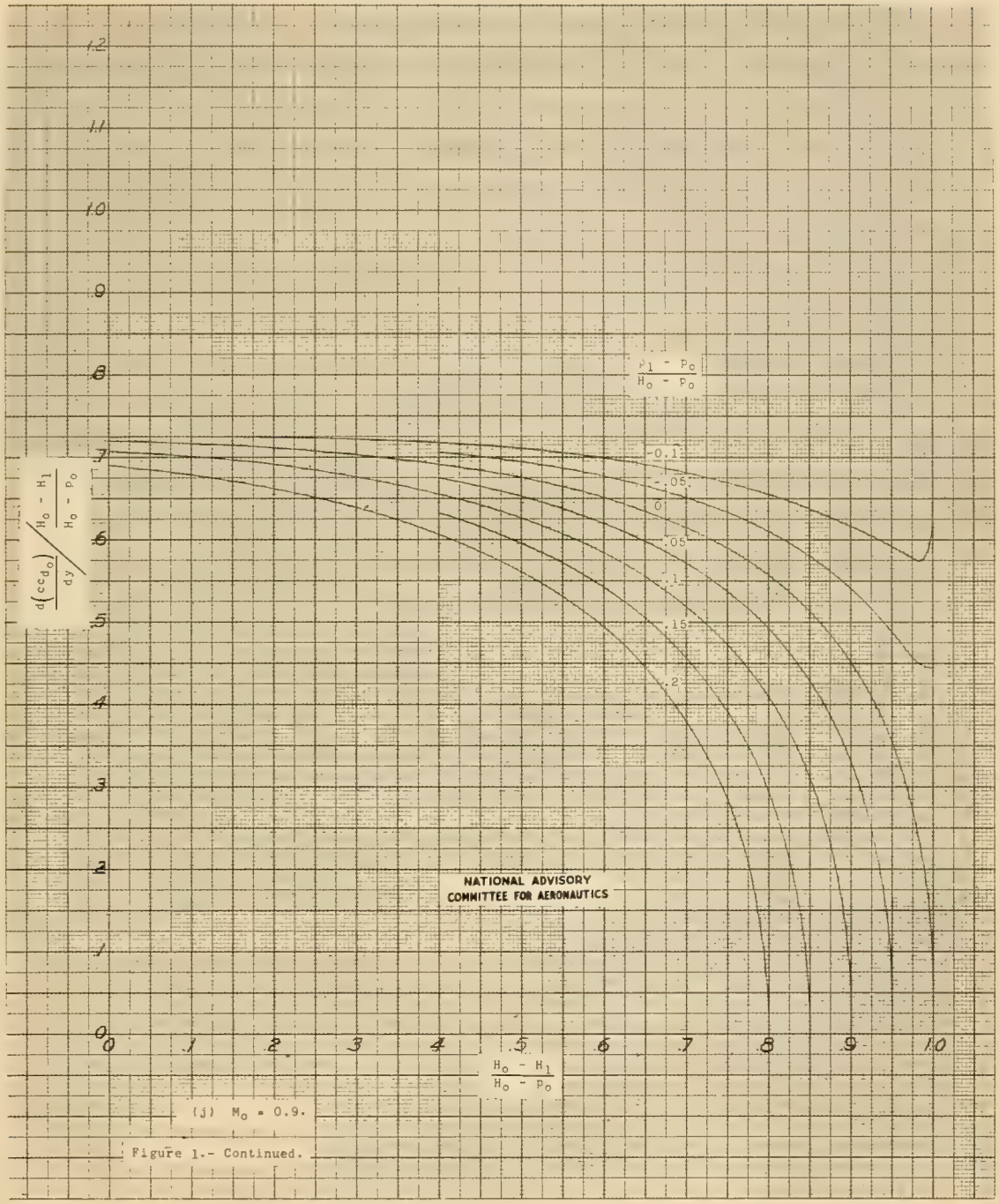


Figure 1.- Continued.



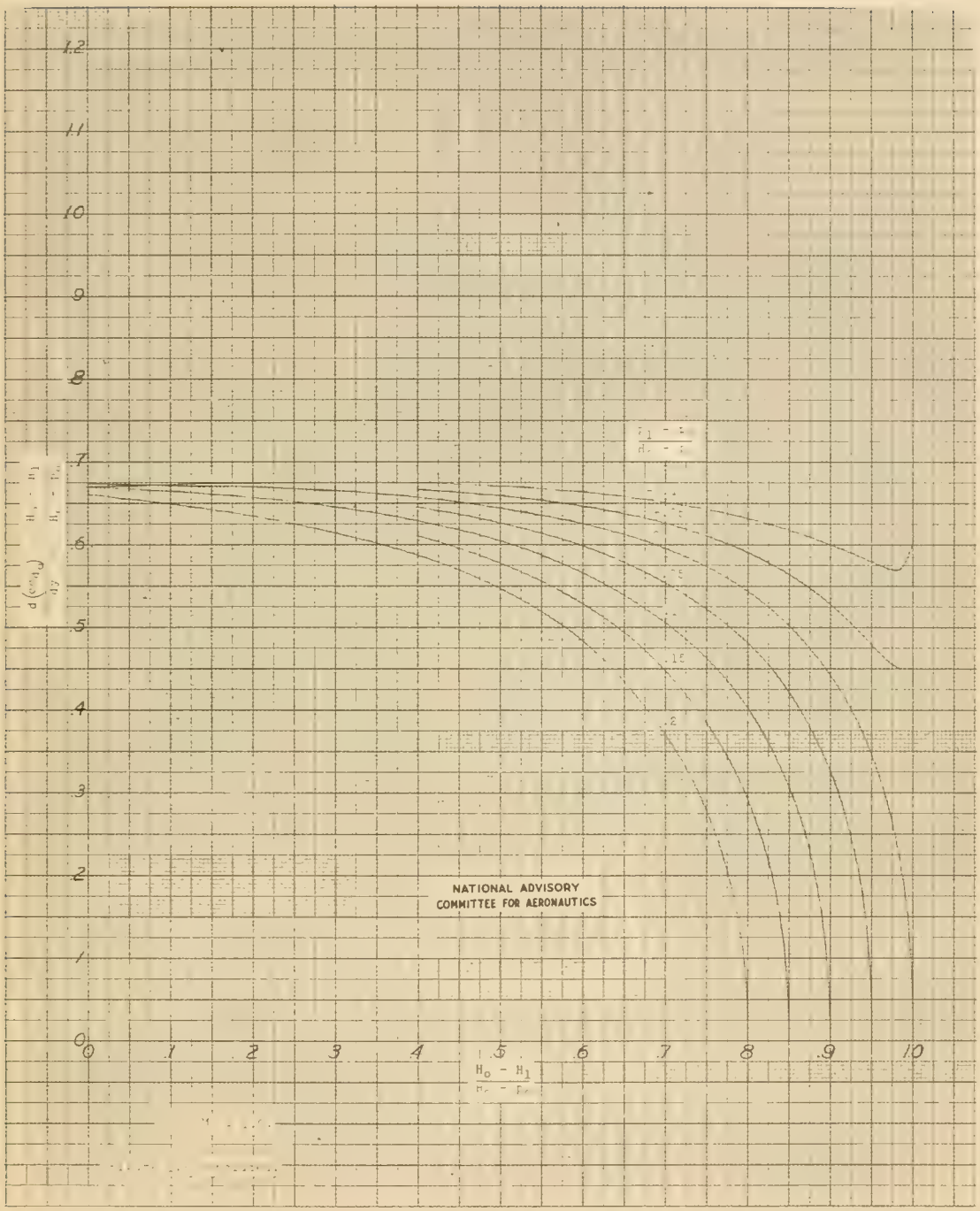
(i) $M_o = 0.8$.

Figure 1.- Continued.



(j) $M_o = 0.9$.

Figure 1.- Continued.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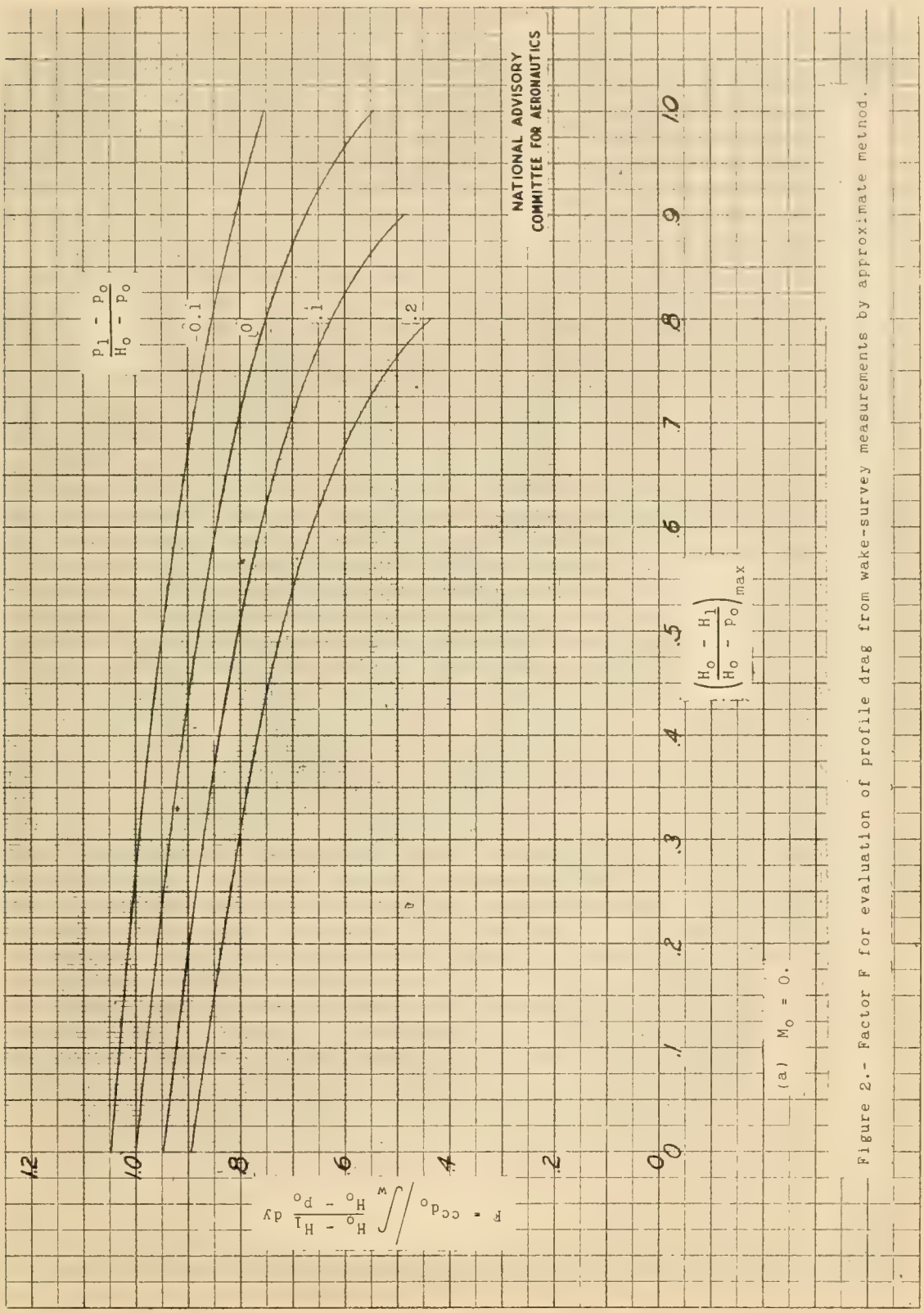
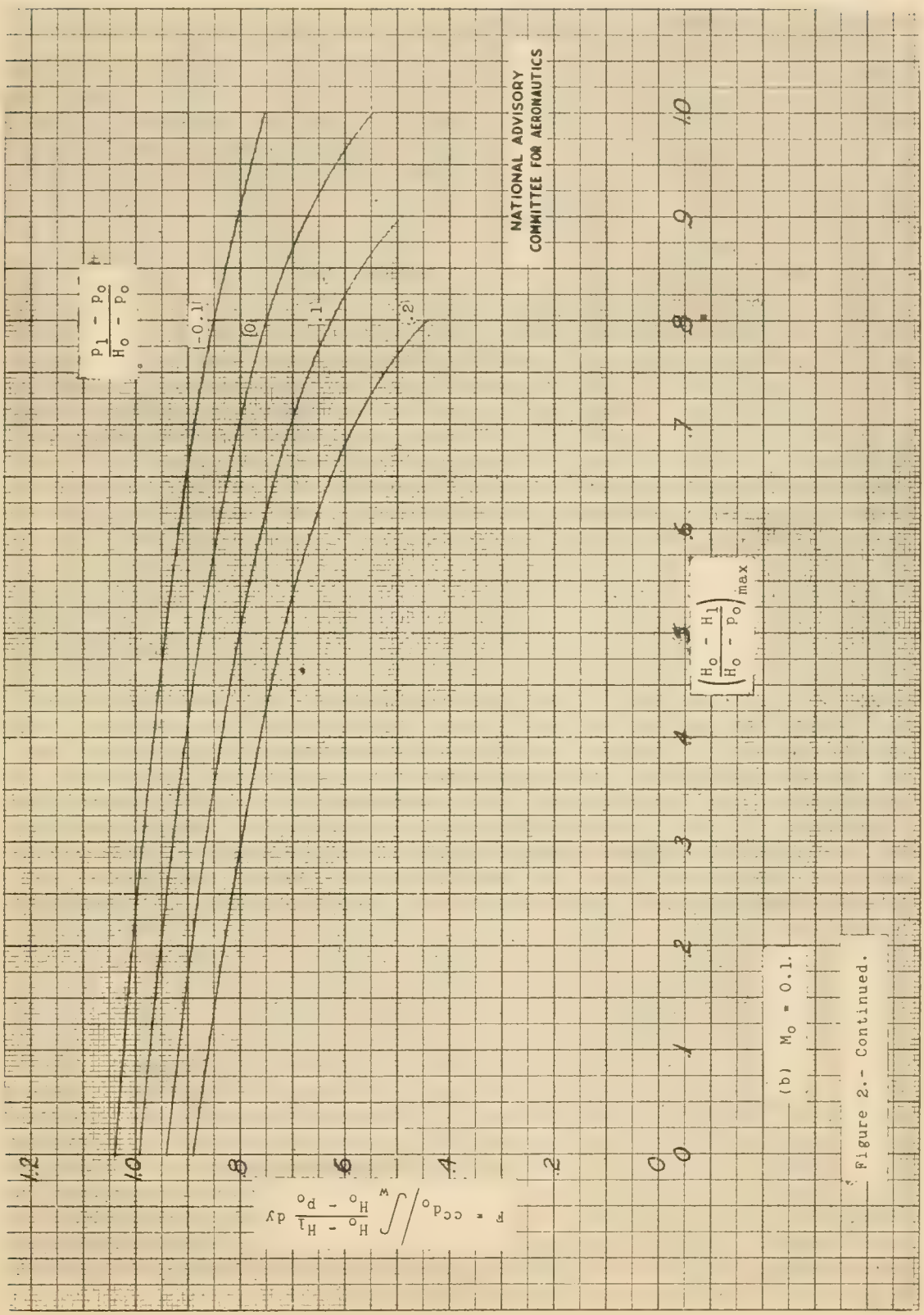
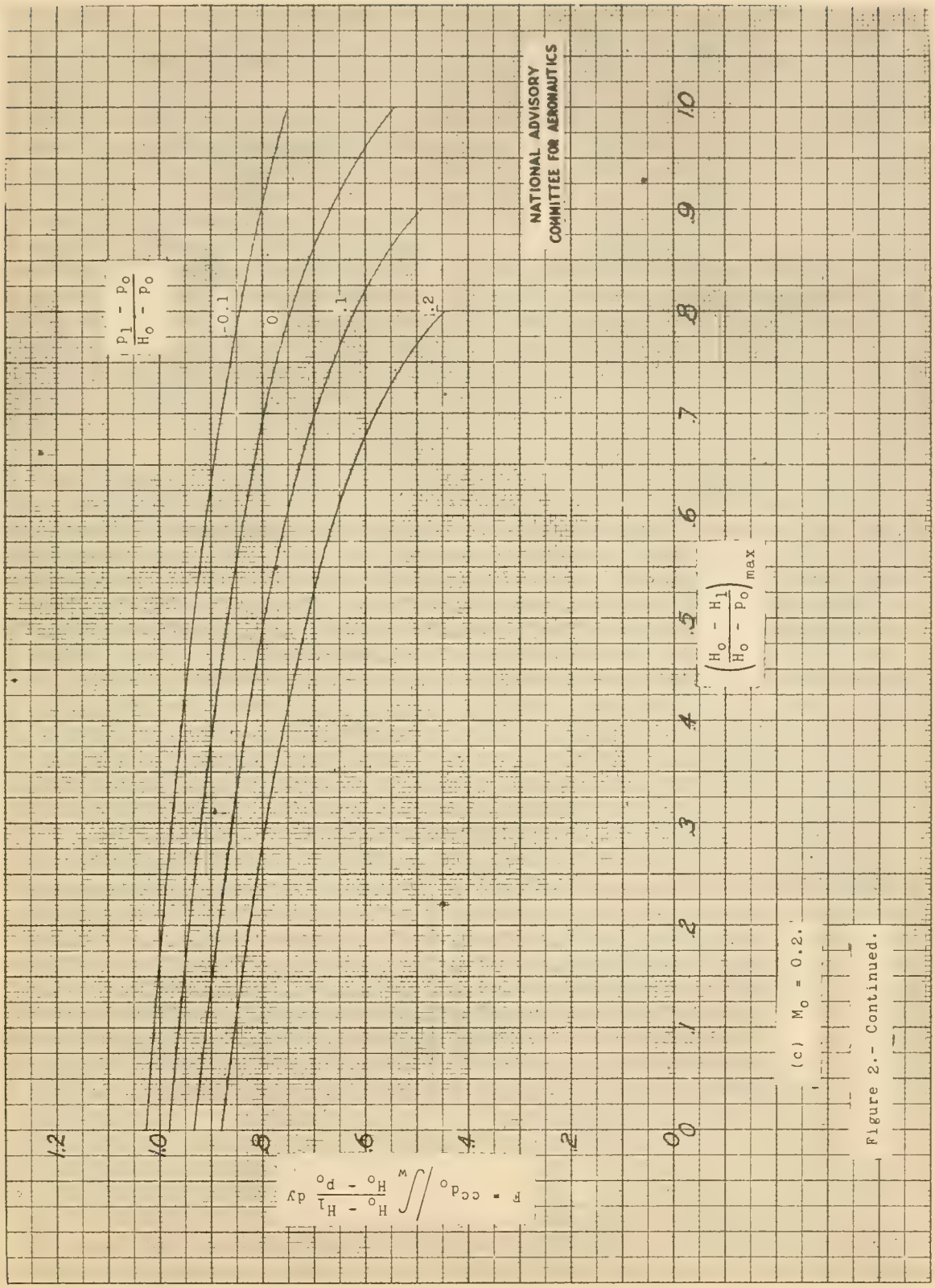


Figure 2.- Factor F for evaluation of profile drag from wake-survey measurements by approximate method.



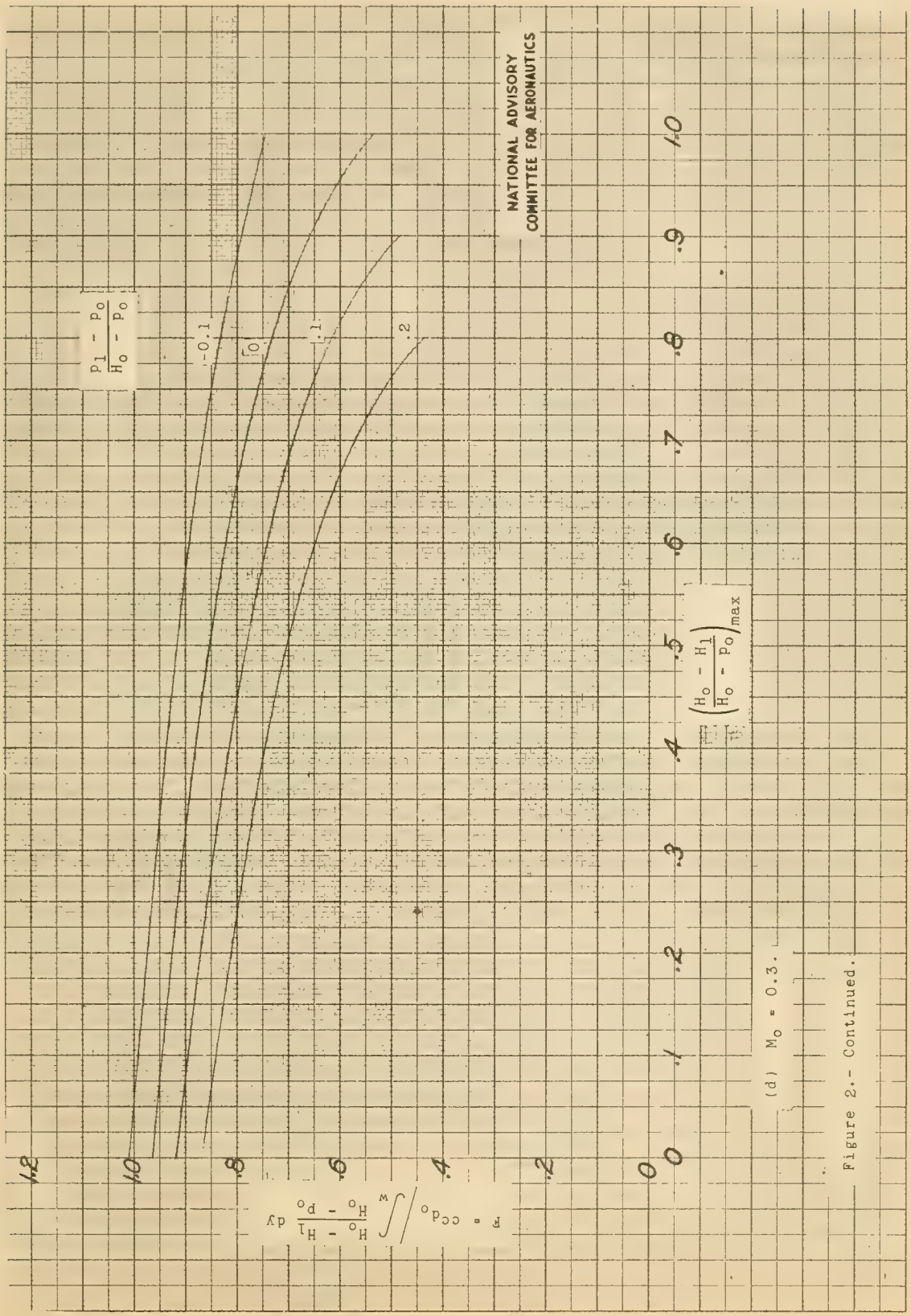
(b) $M_o = 0.1$.

Figure 2.- Continued.



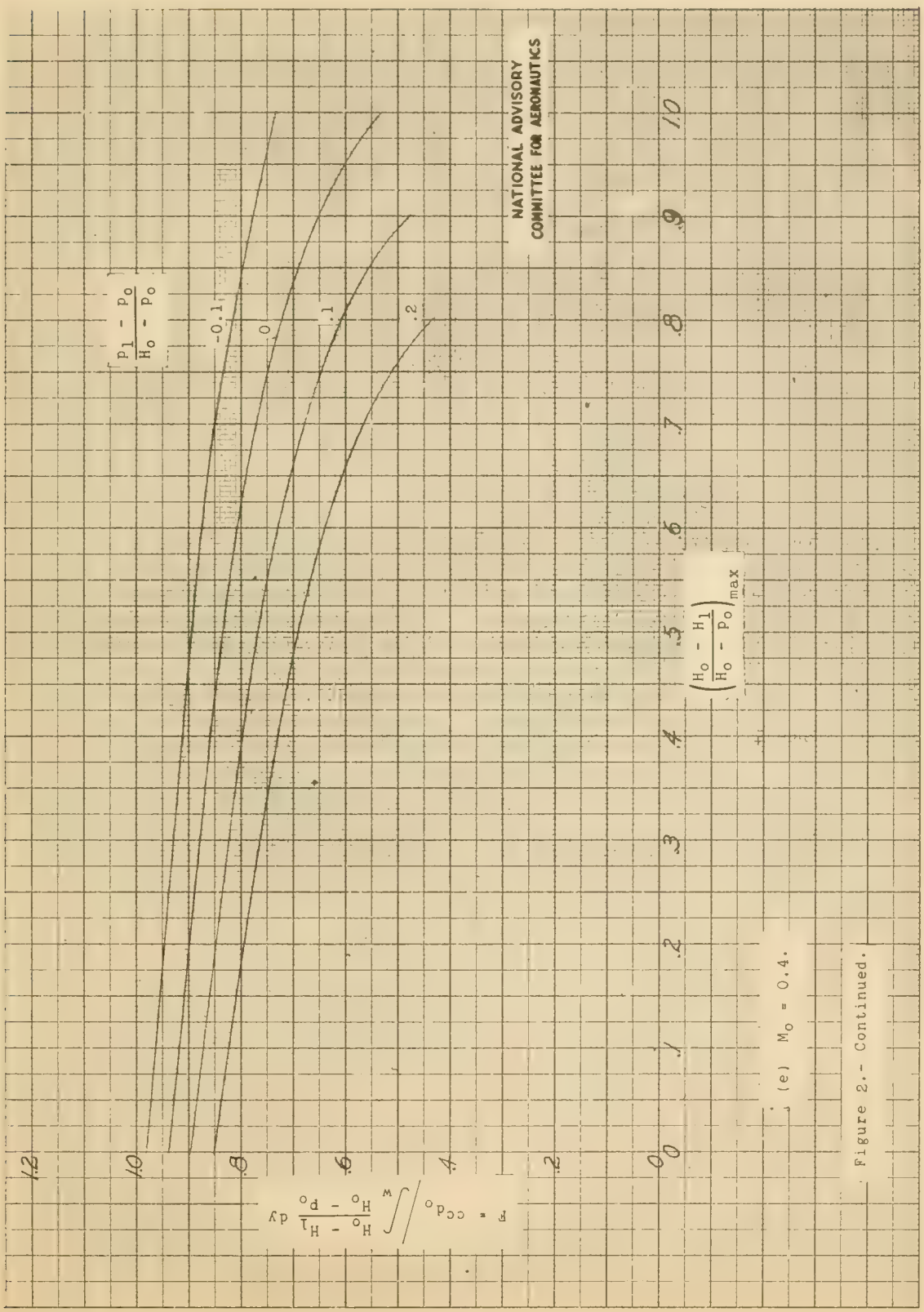
(c) $M_o = 0.2$.

Figure 2.- Continued.



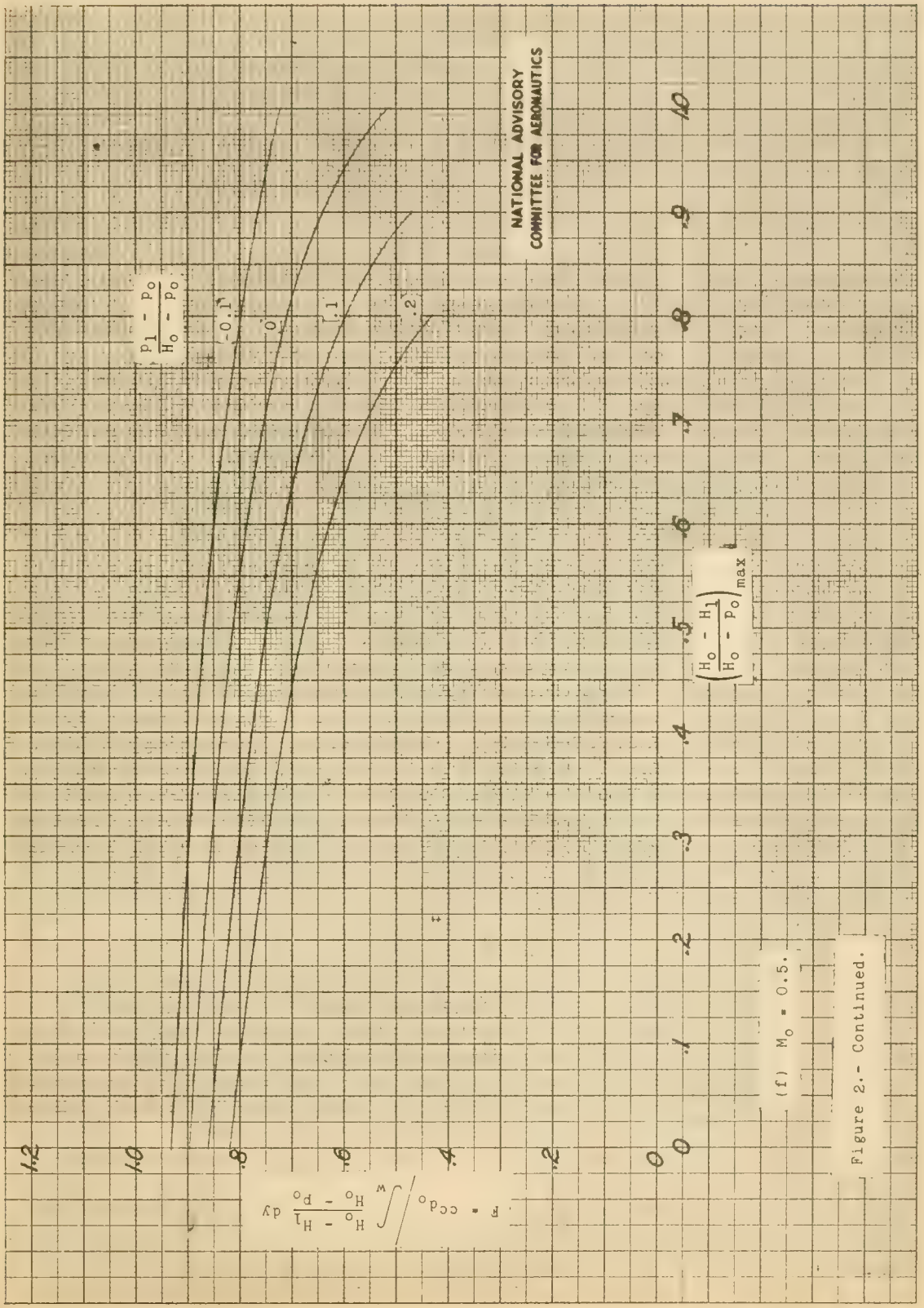
(d) $M_o = 0.3$.

Figure 2.- Continued.



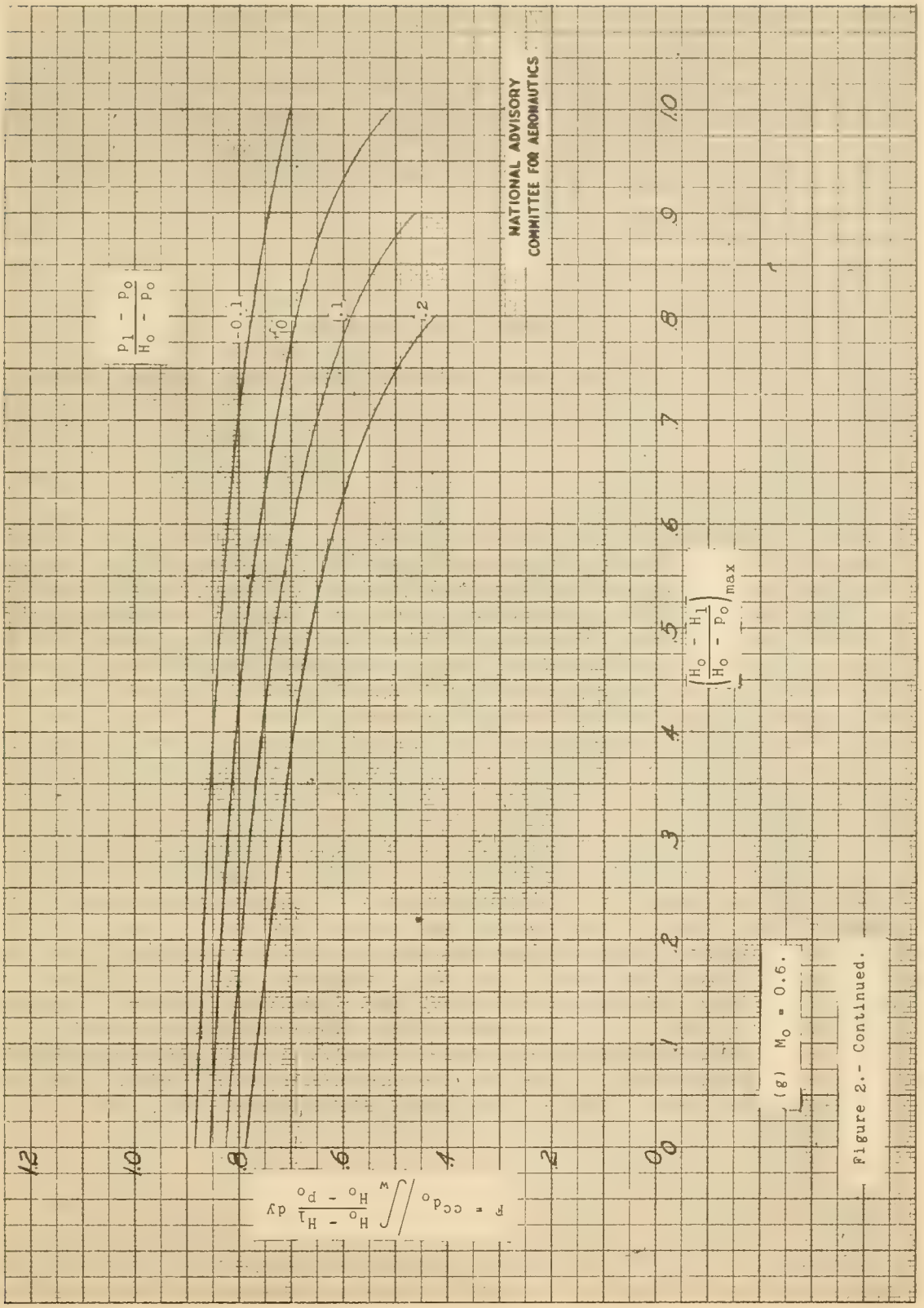
(e) $M_o = 0.4$.

Figure 2.- Continued.



(f) $M_o = 0.5$.

Figure 2.- Continued.



(g) $M_o = 0.6$.

Figure 2.- Continued.

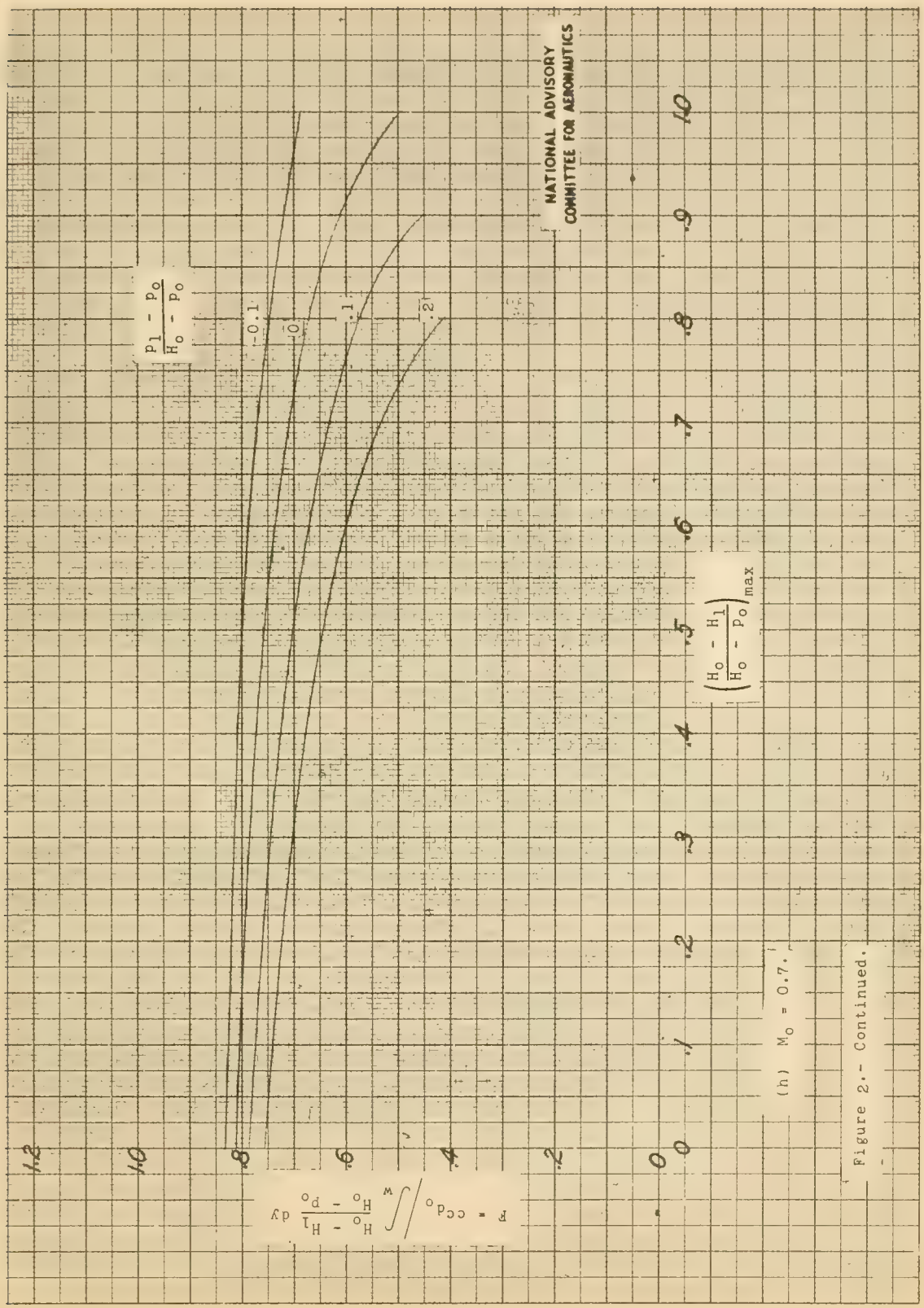


Figure 2.- Continued.

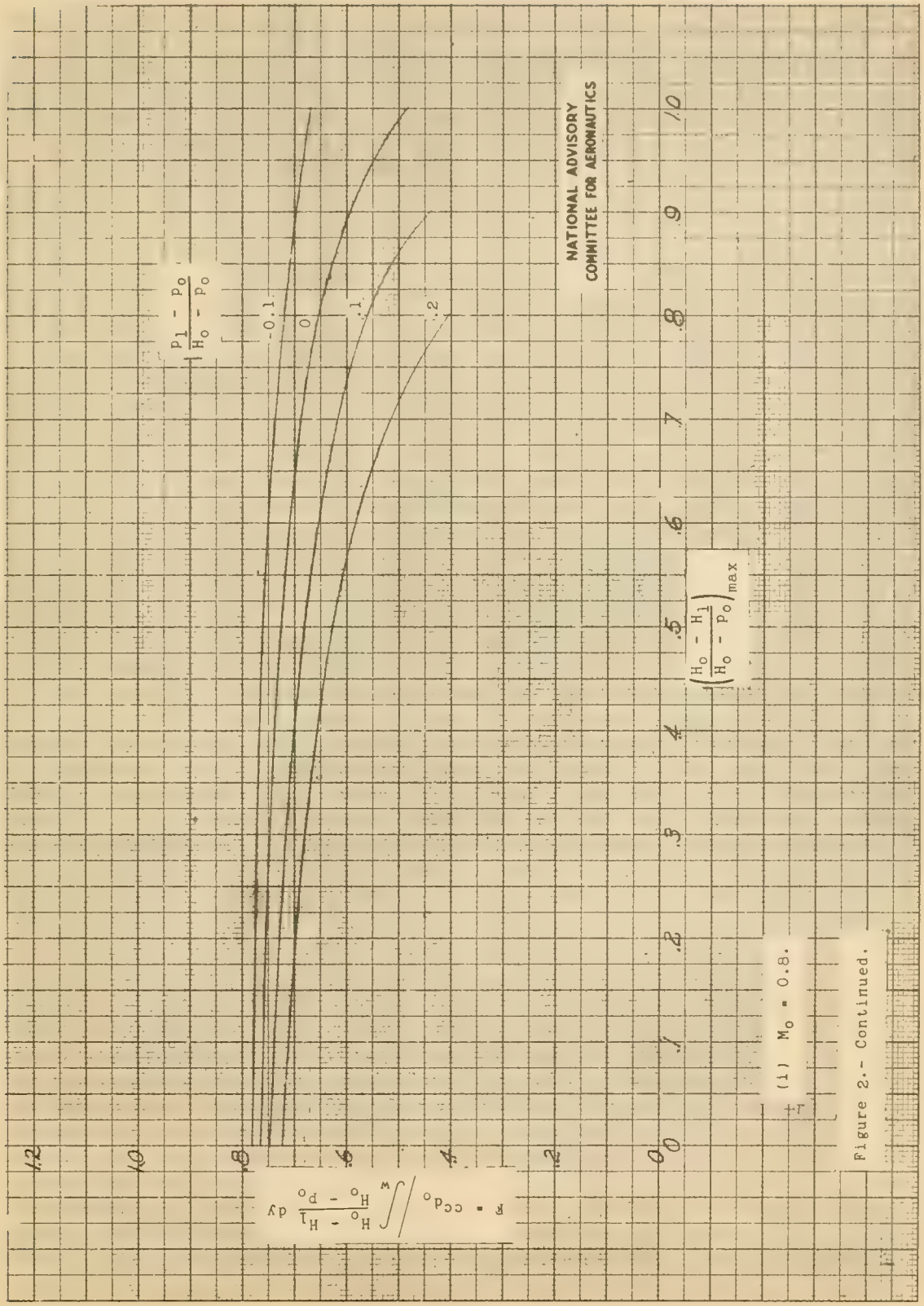
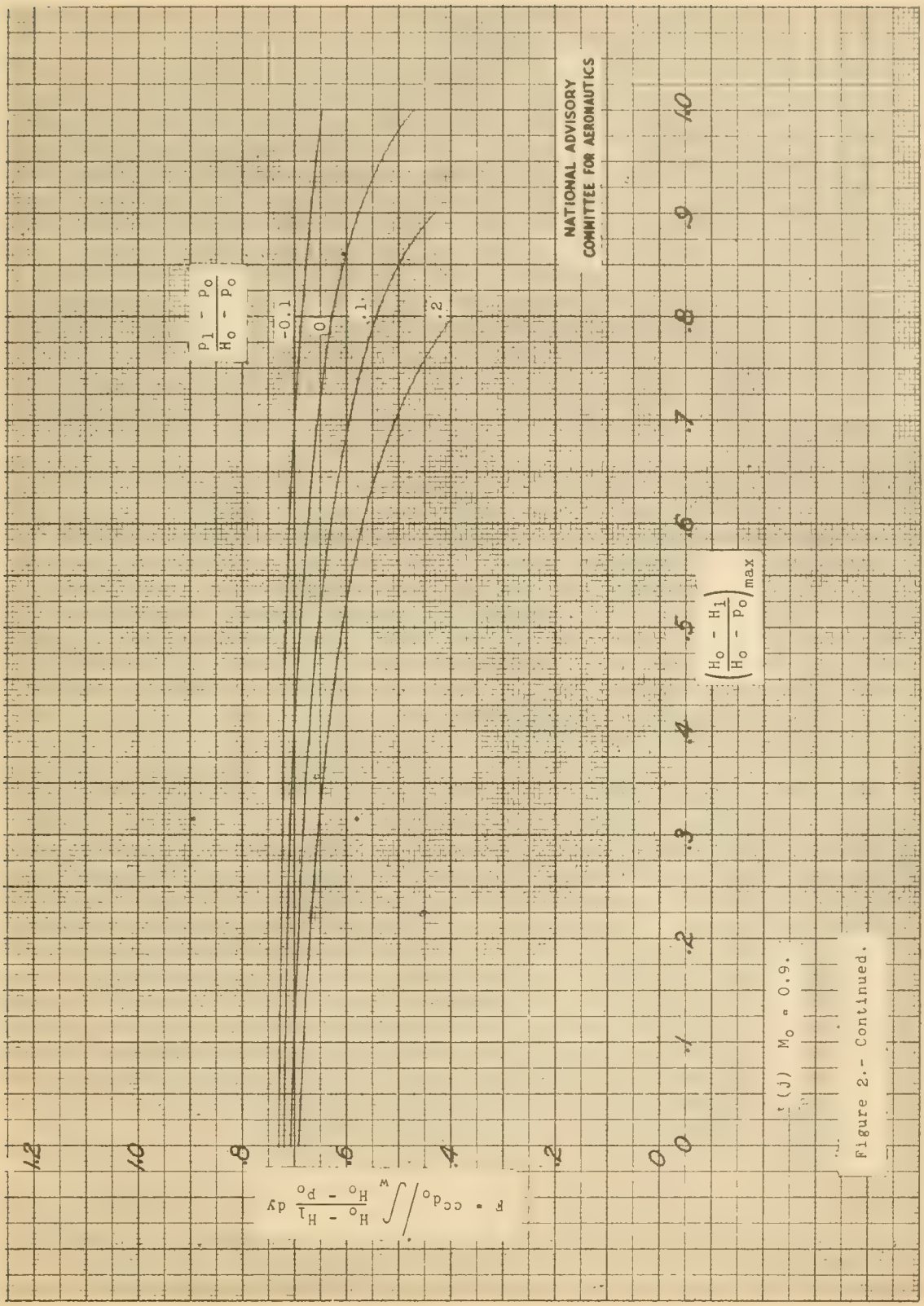
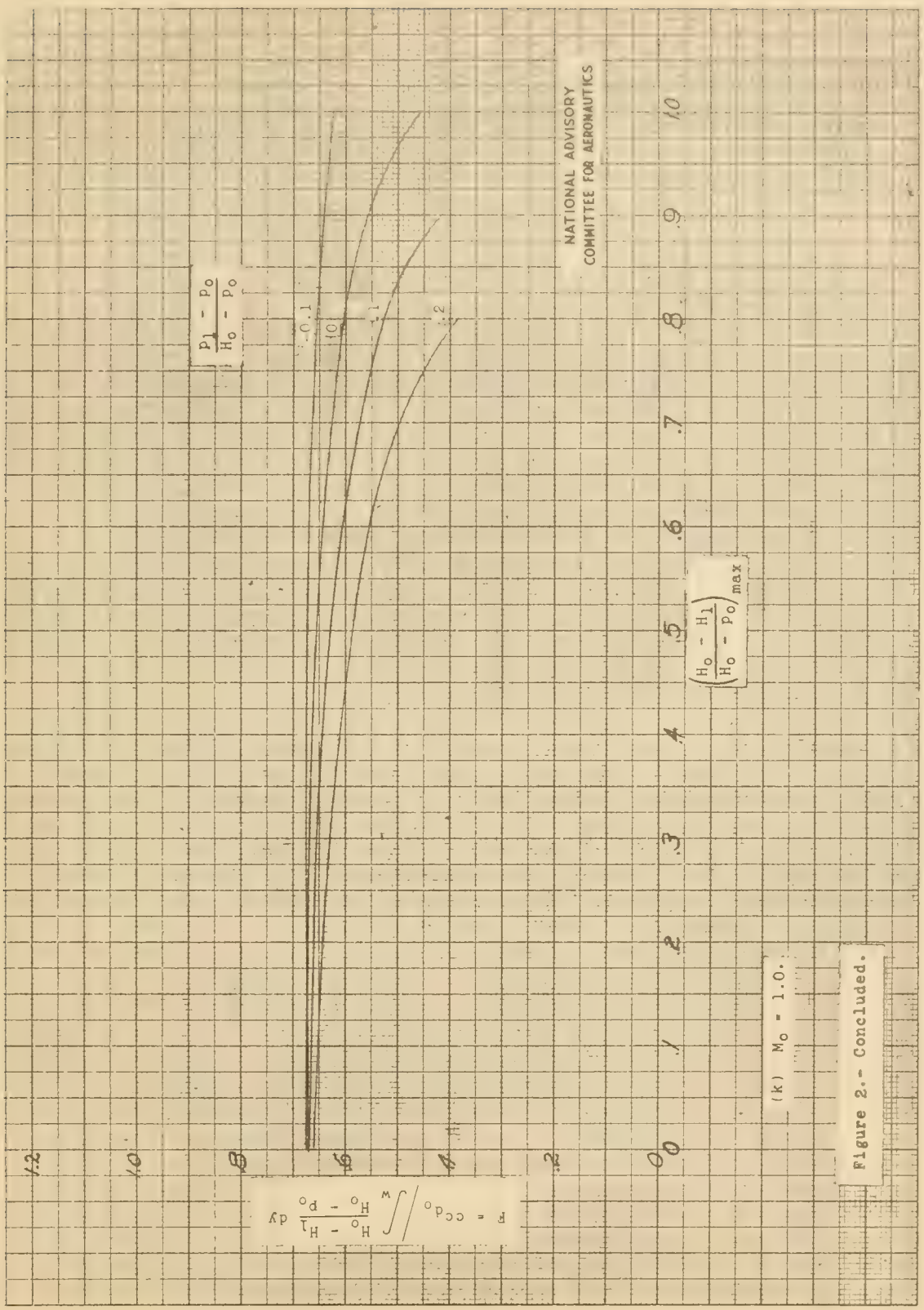


Figure 2.- Continued.



(j) $M_o = 0.9$.

Figure 2.- Continued.



(k) M_o = 1.0.

Figure 2.- Concluded.

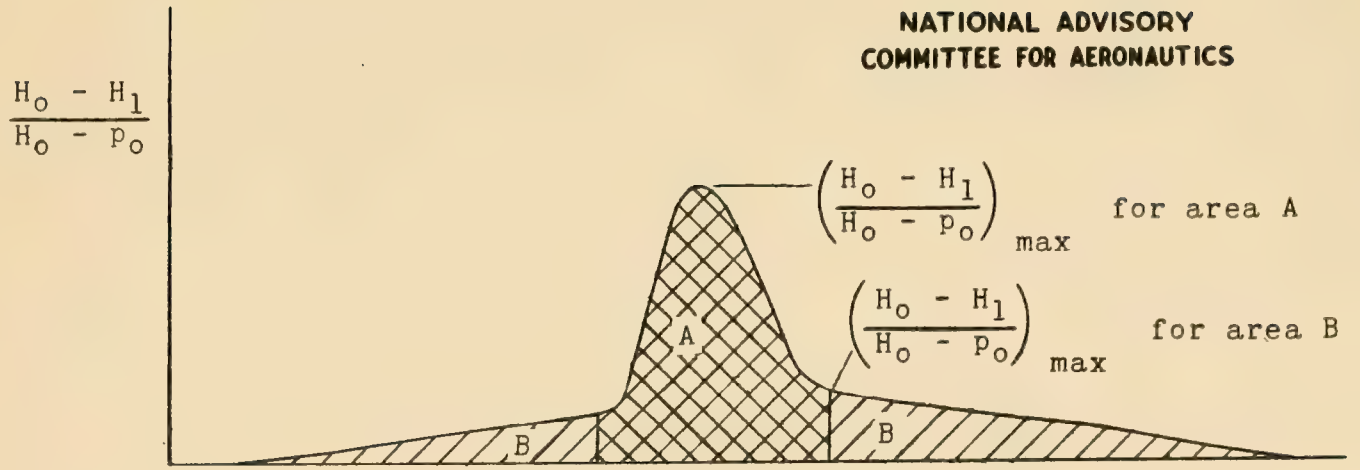


Figure 3.- Separation of wake profile into two parts for application of the approximate method.

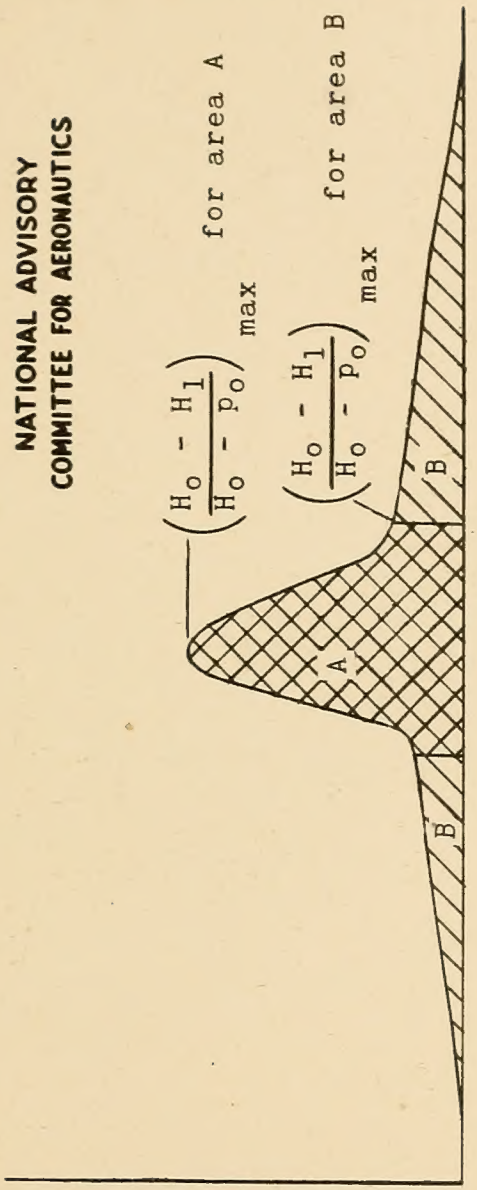


Figure 3.- Separation of wake profile into two parts for application of the approximate method.

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